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The Welsh Engineers' and Founders' Association
The Foundry Trades' Equipment and Supplies Association

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Intelligent Inspection

Engineering inspection is divisible into two categories—that imposed by the great national buying authorities, and internal inspection instituted with the object of maintaining and improving the standard of quality. Unquestionably the personnel of the second type has been influenced in its outlook by the former, whereas in reality there is but little in common. The official inspector is provided with a specification, and, generally speaking, all materials responding to the limiting clauses imposed are passed by him as satisfactory, the balance being either rejected or made the subject of discussion between the authority and the manufacturer. The progress inspector, on the other hand, is employed with the object of preventing waste resulting from work being done upon defective components or permitting the despatch from the works of goods not conforming to the recognised standard.

The major difference between the two types is that the official inspector is not in the least concerned with the elimination of waste, his object being to ensure that the goods conform in every way to the clauses of the specification. Because of the added responsibility of the " inside " man, he should devote the maximum amount of attention to the causes of deterioration of the components. For instance, the labourer with the watering can, used for keeping down the dust, has been responsible for more wastage than would seem apparent. In the preparation of sheets for enamelling, the sweeper in the rolling mill can inadvertently ruin quite a quantity of material. Even the use of unsuitable tools for handling sheets can increase the discard. Through the intelligent inspection of batches of cores, a recurring type of defect can often be traced to one particular " shell carrier," or to an ill-fitting core box, whilst, similarly, one defective half moulding box will be the cause of constantly recurring bad joints in the finished casting.

The type of inspector whose sole object in life is to condemn as much materal as possible as being defective has no place in any progressive organisation. The inspector's reports should be made almost hourly to the foreman, not so much on obviously defective components, but on tendencies, as no person is in a better position to state where deterioration is setting in. He can judge from the amount of steam leaving the cast-up boxes the moisture content of the sand; he can often detect irregularities in the operation of a core stove before the core-shop charge hand, and he is in a position to note immediately when a moulding machine begins to make slightly defective moulds. In the last case, if the moulder is on piece-work, he will naturally continue to operate in the hope that the trouble he is experiencing is only of a temporary character. The efficient inspector will always note the behaviour of the most difficult castings in production, for quite often they form the best barometer for overall plant efficiency.

Where trouble is noted, it is essential that he takes no action other than to report as quickly as possible to the executive in charge, strong though may be the temptation to arrest production. There may be cases, however, where he is given specific permission to take such measures. As the inspector obviously must be a " nosey Parker " to be efficient, it is all the more incumbent upon him to be as circumspect as possible in his dealings with his colleagues. By following a correct attitude he will learn much to help him in his task of waste reduction. In some organisations, the inspector reports directly to the works manager, but to our mind this is a mistake, and productive of more waste than it will eliminate. His obvious chief should be the head of the department in which he is employed. Even where the system is such that an inspection department, replete with its own chief, exists, we still maintain that the individual inspector should be attached to the staff of the shop in which he works. Under the reverse conditions, the inspector is liable to deteriorate to the level of a " go " and " no go " checker.

If an inspector properly fulfils his job, he is a real asset to the foundry executive, for under the present high-production conditions, the latter is sufficiently occupied with planning operations, and the best utilisation of labour. To be constantly informed of quality tendencies —for amelioration as well as deterioration should be reported—is of the greatest help to the busy executive. Moreover, the inspector should be warned in advance of any changes which are being put into operations, so that he can give an immediate opinion as to their influences on the quality of the product.

When new men are employed, their training and future advancement will be guided by confidential reports to the foreman as to the quality of the work they make. Where, by the installation of better heating, lighting and ventilation arrangements, quality is shown to improve and waste to be reduced, then an official report should be drawn up, for obviously the direction will require to know the result of its enterprise from this as well as from the angles of increased production, lowered rate of accident incidence, and the like. Devoid of any responsibility, other than waste reduction and quality maintenance, the intelligent inspector is as indispensable to a modern large-scale foundry organisation as a signalman is to a railway company.

Changed Copper Outlook

By "Onlooker."

After the collapse of France, when it became apparent that American copper producers with interests in South America would be left with unfulfilled contracts on their hands, the opinion gained ground that the export price of the metal would be forced down possibly as low as 7 or 8 cents. This export price represented in effect the world price, for in this country the quotation is controlled, while in the States there is a 4 cent import duty which virtually shuts America off from the rest of the world. For a time it certainly seemed as if this prophecy would be proved correct, for business with overseas buyers was done at around 10 cents, the quotation settling down finally at 9.90 cents f.a.s., which was rather a nominal figure, for sales were probably made both above and below this price.

It was known that Chilean copper was hanging fire pretty badly, and for a time it looked as if a marked downward trend would develop on the U.S. domestic market. Custom smelters were shading 11 cents, and transactions were actually reported as low as 10.45 cents delivered Valley. Matters were not so bad, however, as they had at one time appeared to be, the first hint of an improvement coming when it became evident that August would be a good month so far as deliveries to consumers were concerned.

September Sales Record

This was due in no small measure to the additional trade accruing to the rolling mills through orders placed by the British Government in the United States, and when on top of this came the announcement of an intensive rearmament programme by the authorities at Washington a definite check to the price decline was soon followed by an upward movement. September proved to be a notable month, for sales set up a new record at more than a quarter of a million short tons, quite a fair proportion of which was placed at 12 cents, to which point the quotation had advanced. All talk of a glut of copper died down, and in place of it came suggestions that supplies after all might not be any too plentiful in view of the fact that fabricated goods and semis in brass and copper would be crossing the ocean to Britain, even though the manufacturing plants here were being fed with metal of Empire origin.

The next development was a stiffening of the f.a.s. price due to the action taken by fabricators in buying copper of foreign origin lying in bonded warehouses in the U.S.A. for conversion into fabricated material required for export. This bonded copper is presumably of South American origin, and its withdrawal for re-export in a manufactured form, coupled with the fact that a measure of output curtailment in Chile is understood to have been effected, lends colour to the belief that we have seen the worst of copper prices in New York for the present. Actually the latest advices from across the Atlantic suggest that outside interests are asking 12¼ cents delivered Valley.

It is believed that the National Defence Commission in America has no more use for high prices at this time than the British Ministry of Supply, and that being so it must be assumed that 12 cents—which is, after all, well above the parity of the controlled maximum on this side—will be regarded as quite dear enough. As a matter of fact, producers ought to be doing quite well at that figure, and although deliveries of refined copper in the States have for two months running exceeded 96,000 short tons and stocks are well below the 200,000 ton level, a general advance beyond 12 cents would seem to be unlikely. Nevertheless, the outlook has changed, and from gloomy prognostications there is now an inclination to look for a price level of 12 cents or better.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

"Brass Chandelier"

To the Editor of The Foundry Trade Journal.

Sir,—In Mr. V. C. Faulkner's generous review of my book, "Brass Chandelier," appears the following sentence:—"He (*i.e.*, Best) was . . . a sociologist devoid of sufficient courage to apply the precepts within his works' organisation, but who probably made a mental compromise by throwing his energies into the Adult School movement and municipal reform activities, for he neglected both ventilation and adequate lighting within his own shops."

I do not consider your reviewer's opinion does justice to R. H. Best's activities, and I regret that he should have received this impression from the biography which I have written. If R. H. Best's conduct is considered in relation to the standards of his time, he was ahead of them in putting into practice his own social theories. This, at any rate, is the opinion of many who came into contact with his business, and this is the view that I hoped to "get across" in my book. Surely, the account of the Joint Medical Fund and other measures described in Chapter 5 of Part II is sufficient indication that he gave practical shape to many of his own ideals? As for neglecting ventilation, I would draw your reviewer's attention to p. 128, describing his ingenious and, on the whole, successful attempts to use the principle of convection currents to ventilate the shops and the foundry.—Yours, etc.,

R. D. Best.

5, Westbourne Road, Edgbaston,
Birmingham.

October 26, 1940.

Specifications for Aluminium and Aluminium Alloys

To meet a widely-felt need, the technical staff of the Northern Aluminium Company, Limited, have compiled a fully classified summary of current D.T.D. and B.S. Specifications relating to aluminium and aluminium-alloy products. This publication should be useful to all engaged in working to light-alloy specifications. The number of such specifications is relatively large, and the booklet, which is of a convenient size, has been compiled in order to provide ready reference by technical personnel in the numerous manufacturing concerns now working for the first time on light-alloy materials to standard specifications.

The full range of British light alloys as specified at present is classified according to the various forms in which each is produced, namely, ingot, sheet and strip, bars and sections, tubes, wire and rivets, forgings and castings. The appropriate D.T.D. and B.S. Specifications are shown under each heading, with the proprietary nomenclature and tables of chemical composition and mechanical properties. A tabulated summary of proprietary alloys in alphabetical order, showing the corresponding specifications and the forms of material to which they apply, is also given. Copies of this publication may be obtained free of charge by applying to the Research and Development Department of the Northern Aluminium Company, Limited, Banbury.

Gift to Model Foundry

The model foundry installed in the University of Cornell has been equipped with a new shot-blast plant, the gift of the American Foundry Equipment Company of Mishawaka, Ind.

Random Shots

"Your money or your life," the highway robbers used to demand. To-day the modern version is "Your metal and your bones." Then one was given a choice, to-day they demand both!

* * *

The pessimist up-to-date is the man who regularly dines in town, but invariably rings up his home before leaving for the suburbs. If the bell tinkles at the other end, he takes this as a fairly reliable indication that all is well, presses Button B, gets his tuppence back, and proceeds to travel home.

* * *

As a war emergency, the Central Electricity Board has been given power to generate electricity. Surely, if it is given to them, why bother to generate it themselves?

* * *

Wartime Cooking Note (*from "Trade Talk"*).

". . . Ordinary baked cores are stated to be improved by dipping them in a mixture made up of 1 pint of molasses, 10 lbs. of graphite, 1 lb. of Sulfatate and water sufficient to make them up to 5 galls. The cores are then re-baked." One assumes that this is a Monday dish, the best parts of the apples having been served up on Sunday.

* * *

Behind an insignificant little parenthesis in the latest report from the West Riding Branch of the I.B.F. lies a story of devotion to duty and rare determination to "see it through." The parenthesis referred to reads as follows: "Mr. H. H. MacColl, B.Sc. (now of Walsall)." It appears that whilst Mr. MacColl was Vice-President of the West Riding Branch, he accepted an academic appointment in the Midlands, but instead of resigning from his vice-presidency he travelled backwards and forwards from the Midlands to Yorkshire (a distance of 300 miles there and back) to attend the meetings; since then he has become President of the Branch and fully intends to be present at all the meetings this session. It is interesting to note that the discussion after his presidential address at the first meeting of the session was on "wartime difficulties." It is quite obvious that Mr. MacColl at least does not admit of such things. He just rides over them—all three hundred of 'em.

* * *

Apropos of wartime difficulties, a friend was discussing this subject with the Editor the other day. "I should think," said he, "that the most awkward person in your sphere of work is the everlasting Censor." "Good gracious, no!" replied the Editor. "The most awkward fellows I have to deal with are the celebrities who will persist in dying on press day!"

* * *

The week's best crossword clue is from "The Times."

Clue.—An ill-wind, for Germany.

Answer.—Hurricane.

"Marksman."

High-Speed Radiography

Development of a new cold-cathode ultra high-speed X-ray tube that makes millionth-of-a-second radiographic exposures was recently described before the American Physical Society by Dr. C. M. Slack, of the Westinghouse Electric & Manufacturing Company. It is believed that the development of the tube extends the possible usefulness of X-ray science into a wide new realm. It may make possible X-ray motion pictures and study internal strains in rapidly moving parts of motors and machinery, revealing rapidly moving opaque objects or the effect of sudden forces on such objects.

Cupola Practice

A PRACTICAL DISCUSSION AT DERBY

The East Midlands Branch of the Institute of British Foundrymen held the opening meeting of the 1940-41 session at the Jacobean Café, Derby, last month. Mr. R. H. Buckland, the retiring President of the Branch, extending a hearty welcome to the members, expressed the hope that, despite the fact that the year was likely to prove a difficult one, they would continue to give their new President, Mr. S. E. Dawson, every support.

Mr. Dawson said that the Branch Council had met some time ago to arrange the session's activities, and a good deal of thought was given to the advisability of providing a full programme of lectures. It was decided that the best interests of the country, the industry and the members would be served by endeavouring to carry on as usual. This was also the wish expressed by the President of the Institute and the General Council, who had reminded them that under such circumstances as the present the fullest interchange of ideas was of the greatest value. A good series of lectures had been arranged, and in each case a specialist had been secured to deal with the particular subject. In order to meet the convenience of those who might have to travel some distance, the meetings would be commenced promptly and the discussion kept as concise as possible. For this reason Mr. Dawson did not propose to conform to the usual custom at the first meeting of the session, by making a lengthy presidential address. He did wish to convey to the members, however, his thanks for the honour accorded in electing him as the President for the coming session. He assured them that he would endeavour to carry out the duties to the members' satisfaction—a task of some difficulty in view of the high example set by the retiring President, Mr. Buckland.

Mr. Dawson then asked Mr. L. W. Bolton to present his lecture on "Ordinary Cupola Practice." It might be mentioned that the Council had asked the lecturer to give members the benefit of his experience on the melting of high-steel charges in the cupola, a subject upon which Mr. Bolton was an expert and one which was important at the present time.

ORDINARY CUPOLA PRACTICE

Mr. L. W. Bolton (British Cast Iron Research Association) said that many foundries at the present time were being called on to produce castings to meet more rigid analytical specifications than previously. The production of such irons necessitated very careful control of melting practice, and the main purpose of the Paper was to assist the average foundryman to meet these new conditions, so far as cupola practice was concerned. An examination of melting practice in a large number of foundries had shown that there were three main points which could well receive more attention. These were the measuring of the charges, the control of air supply and the mixing of the metal after melting. Other factors also occasionally required attention, and these would be briefly considered.

Charges

Dealing first with the materials put into the cupola, the lecturer said that if a constant temperature was desired, the metal charges should be weighed. In certain cases, the coke and limestone could, however, be charged by volume if check weighings were taken periodically. The metal should be broken up into pieces not longer than one-third the diameter of the cupola. Any tendency for the charges to bridge must be avoided, as this was a common cause of erratic melting. The charges should descend smoothly throughout the melt. In cases where bridging was a serious difficulty, it could sometimes be overcome by increasing the internal diameter of the lining in the preheating zone.

Coke should be of uniform size. Large coke was desirable, especially on large cupolas, as small coke was often a sign of low strength and suggested that the fuel had been broken up by handling during transportation. If a coke had a low strength, it would not give the best results in the cupola. Apart from analysis, the shatter test was one of the most useful for assessing the quality of a coke.

With regard to fluxes, limestone was by far the most widely used, although dolomite gave good results and a fluid slag. The substitution of a part of the limestone by fluorspar, as recommended in a recent Paper, had been tried with success and assisted in keeping sulphur pick-up to a minimum.

Air Supply

Air supply rarely received sufficient attention, although in many cases the blowing equipment was capable only of meeting the normal air requirements of the furnace and had nothing in reserve for use in an emergency. Pressure was more easily measured than volume, but few founders made use of the relation between volume and pressure. This relationship, which could be expressed as

$$V \text{ varies as } \sqrt{P},$$

where V was the volume of free air, and P the pressure in the wind belt, had been shown to be substantially correct for the air supply to cupolas. When conditions were reasonably constant, the pressure could be used as an indication of the volume; for example, if it was known that with a pressure in the wind belt of 16-in. water gauge, the volume was 2,000 cub. ft. per min., and another pressure reading when the cupola was working under otherwise similar conditions showed 25-in. water gauge, then the increase in volume must be in the relation $\sqrt{25}$ is to $\sqrt{16}$, or 5 is to 4, an increase of 25 per cent., equivalent to a volume of 2,500 cub. ft. per min. It must be borne in mind, however, that when the wind-belt pressure was equal to the maximum pressure against which a fan would work, the pressure was not a guide to the volume of air entering the furnace. The volume might then be high or it might be very low, depending on the resistance to the blast.

Mixing the Molten Metal

Speaking of the necessity for securing good mixing of the molten metal, the lecturer pointed out that, in order to obtain metal of regular analysis, it was essential that the metal should be given adequate opportunity to mix before it was poured. This was probably not so important where charges contained only pig-iron and scrap of roughly similar composition, but where the charges contained components of widely differing analysis, for example, steel and pig-iron, two charges should be collected either in the well or in a ladle, before metal was taken for pouring. If metal was tapped and poured when less than one whole charge was collected, as his experience had shown was sometimes the case, then erratic results were inevitable. Attention paid to providing adequate opportunity for mixing the molten metal was well worth while.

Melting Steel Scrap

Many foundries now required to use higher proportions of steel scrap in the charges in order to produce high-strength irons. In melting high-steel charges, certain special precautions were necessary if trouble was to be avoided. For melting mixtures containing, say, 50 per cent. steel scrap, the first essential was a good coke bed, and this should be made up to a height 3 ft. to 3 ft. 6 in. above the tuyeres. On no account should any attempt be made to force the melting rate, and a soft blast should be used. This was necessary because steel oxidised more easily in the cupola than cast iron, and the velocity of the gases, and thus the height of the zone in which free oxygen was present, had to be kept relatively low.

It was unwise when melting such mixtures to economise in coke, and a metal to coke ratio of between 7:1 and 8:1 would be advisable. This relatively heavy coke consumption ensured that the height of the bed was maintained and that the exhaust gases were not of a severely oxidising nature.

The lecturer also dealt with the question of sulphur and carbon pick-up when melting high-steel charges, and showed that the ash content of the coke often served as a guide to the pick-up of carbon. Generally speaking, the higher the ash content, the lower the pick-up of carbon obtained. As would be expected, cokes with a high sulphur content gave a high sulphur pick-up, and the first few taps from a cupola usually showed a higher sulphur and carbon figure than succeeding taps.

DISCUSSION

Mr. J. C. Hallamore said Mr. Bolton had referred to adequate mixing, and he asked if that only applied to the actual materials being charged, or had he also in mind the use of a receiver on a cupola? Most people preferred large coke, and from his own experience it seemed to give better results, but was it good practice to use the largest pieces for the bed, and the smaller ones for the charges?

Where unbreakable pieces of large scrap occurred, it was his personal practice to build up a high coke bed, charge in the large lump and allow it to soak at a high temperature. He thereby never experienced any trouble and found the metal sufficiently hot. Another interesting point was that of charging pig on the periphery and the scrap centrally, but he did not think that would be quite so easy on a small cupola. He was glad that Mr. Bolton had stated that an 18-in. furnace *was* a cupola.

Receivers

Mr. Bolton, in referring to the question of insufficient mixing of the molten metal, stated that although receivers did give good mixing, there were disadvantages with this equipment. In his experience, the metal was never quite so hot from a receiver as when tapped direct from the cupola. An advantage of the receiver was that the tuyeres could not be slagged up and the cupola would therefore work more regularly on long melts. Where a high metal temperature was very important, the well of the cupola could be enlarged and used as a receiver, although this was not, of course, possible when very low carbon was required.

He agreed that large coke was advantageous on the bed, but in smaller sizes of cupola, say less than 36 in. dia., it was not so important that large coke be used on the charges. On very large cupolas, large coke should be used.

Referring to large scrap, the lecturer said that when it could not be broken, if extra coke was used, it was possible to get rid of it, but he did not advise using such scrap if the metal were required for important castings. If a large piece of scrap descended into the zone where

free oxygen was present, before melting, it was quite possible that low-temperature metal, low in carbon and silicon, would be produced.

An 18-in. furnace, if built with an adequate preheating space, was a cupola. When correctly operated, these small cupolas would give excellent results, but unless the pig and scrap were broken up very small (it was also advisable to break up large pieces of coke), they could be very troublesome. If bridging occurred, it was a sign that the components of the charges were too large. Bridging must be avoided at all costs, as it led to erratic results, cold metal and severe lining wear.

High Coke Beds

MR. F. G. BUTTERS asked for the reason why, on one of the cupolas at his foundry, they had to put such a high bed to get satisfactory results. On one of them they used a 48-in. bed and the metal came down in eleven to twelve minutes, which was considered a normal time. If the bed was lowered to 3 ft. 6 in., it took about nine minutes and the metal was cold. The cupola was an ordinary 41-in. furnace, with 20 per cent. tuyere ratio, involving the use of 16 tuyeres in all. Another point mentioned by Mr. Bolton was the amount of air per lb. of coke being 115 cub. ft. That seemed to him to be exceptionally low, and he suggested an average figure of 140 to 160 cub. ft. of air.

MR. BOLTON said the reason for the high bed required was probably because there was a very thick lining in the well of the cupola. He had found that with a thick lining the metal tended to cool off very rapidly in the well until the brickwork had become thoroughly heated. Cold metal when starting could be avoided by the use of a high bed. With a lower bed, the first metal was not quite so hot when it came down and might be cold when tapped.

He agreed with Mr. Butters that 115 cub. ft. of air per lb. of coke sounded low. He had dealt only briefly with this subject, and could have enlarged upon it very considerably had there been time. The reason 140 to 160 cub. ft. measured in the blast pipe was usually specified was to take care of losses by leakage from the wind belt and pipe. For complete combustion, about 135 to 140 cub. ft. of air per lb. of coke was required, but in most normal cupolas complete combustion was not attained, and only about 110 to 115 cub. ft. of air per lb. of coke was used. Nevertheless, because of losses by leaks at the tuyeres, etc., it was usually advisable to allow about 150 cub. ft. of air per lb. of coke. Where the blast system was absolutely air-tight, it was surprising how low was the quantity of air needed.

Coke Ash Content and Carbon Pick-up

MR. DAWSON, referring to the opening remarks of Mr. Bolton, said that it was good to hear that the raw materials available in this country were, on the whole, better than those in other countries. American cupola iron was generally considered to be rather softer or easier to machine than British iron of equal analysis, and no doubt Mr. Bolton could give some explanation of this.

Remarking on the very interesting curves shown on the screen indicating the relationship between air volume and pressure, Mr. Dawson said that he assumed a graph had to be derived for each cupola. In view of the variations in ash content and hardness of the cokes referred to by the lecturer, he asked to what extent the carbon pick-up was attributable to ash content as compared with the carbon content and the structure of the coke itself.

MR. BOLTON said that Mr. Dawson's remarks regarding the softness of American castings compared with British castings were interesting. His experience of American foundry practice showed that for certain classes of castings, special attention was paid to producing an iron which was easily machinable. Generally speaking, British founders did not pay the same attention to this property. The average American cupola was larger than that used in this country, and the output per square foot of cross-sectional area was probably lower in the United States than over here, or, in other words, the cupolas were operated more slowly. Mr. F. J. Cook had shown in a Paper published many years ago that forcing a cupola gave a harder iron, *i.e.*, an iron more difficult to machine, without necessarily altering its composition. This might explain the difference referred to by the chairman in machinability of the castings produced in the two countries.

With regard to the properties of a coke which influenced carbon pick-up, there was no doubt that a soft, open-grained coke would usually give a high pick-up of carbon. This would be anticipated, as such a coke presented a larger surface area to the drops of molten metal. Open-grained cokes, however, were usually low in ash and many dense, hard cokes had high ash contents. It was possible that the structure of a coke was a more important guide to its properties than the analysis, but structures were difficult to define and for the practical man to assess, and knowledge of the ash content could be a useful guide to carbon pick-up.

Tuyere Adjustment

MR. H. PINCHIN, referring to the balanced-blast cupola, and the oxidation of steel when melting a steel: cast-iron mixture, asked whether it would be advisable to reduce the blast going through the top rows of auxiliary tuyeres.

MR. BOLTON said the balanced-blast cupola was designed to give the maximum combustion efficiency. When melting high steel mixtures, as already stated, the best results were obtained when some excess coke was used, and under these conditions the efficiency of the furnace was low. The air supplied through the auxiliary tuyeres in the balanced-blast cupola for melting normal pig-iron and cast-iron scrap mixtures would be modified for melting mixtures containing high proportions of steel scrap.

Dolomite and Limestone Fluxes

MR. G. L. HARBACH, referring to the remarks made by Mr. Bolton in connection with the weighing of charges, said that seemed to bring about difficulties, and he asked to what extent he would consider it practicable to weigh. The lecturer had also said that light scrap gave dull metal, and he would like to know the reason. Referring to a recent experience where castings had shown slag patches on the surface, the speaker said the appearance was similar to that when soda ash had been used as a ladle addition and not completely removed. The trouble seemed to coincide with a change from limestone to dolomite as a flux, and disappeared about the same time that limestone was again used. Both dolomite and soda ash gave a more fluid slag than normal, and the query was raised as to whether, in the lecturer's experience, a fluid slag was detrimental.

Slag Conditions

MR. BOLTON, referring to the weighing of pig-iron, said in certain cases (for example, with machine-cast pig-iron) the average weight of individual pigs varied very little. Counting the pigs was then almost as accurate as weighing. It was, however, impossible to assess accurately the weight of a miscellaneous collection of scrap or pieces of pig of various sizes and lengths, and with such materials weighing was essential if accurate control was to be imposed. Flux and coke could be charged by volume.

With regard to the question of inclusions of slag in the metal, his experience had been the more fluid the slag, within reason, the easier the slag separated from the metal and the castings were consequently cleaner. Many founders added fused sodium carbonate to the cupola in order to obtain a fluid slag with beneficial results. A number of founders also used dolomite as a flux, although it must be admitted that the majority preferred limestone. He was unable to explain the trouble to which Mr. Harbach referred, but thought it sounded more the type of defect associated with a sticky slag than with one that was too fluid. Very light scrap would not necessarily give dull metal, but the temperature was not so high as when scrap of medium section was melted. Light scrap melted easily and seemed to run through the cupola without attaining any considerable degree of superheat.

Vote of Thanks

MR. H. BUNTING, in proposing a vote of thanks, said he was sure that, whilst it was an old subject, the members would agree that Mr. Bolton had given them something new that evening. Cupola practice was one of the most interesting sections of foundry practice. There were one or two points with which he did not agree. One was the height of bed charge recommended by the lecturer, which he thought was considerably too high for ordinary practice. Mr. Bunting did not advocate it, or use it, although no doubt from practice on certain lines it had been found necessary and beneficial to use it. No two cupolas would give exactly the same results, and even if they were worked exact in every detail, one still got variations. Mr. Bolton had said he agreed with weighing coke charges. Difficulty was experienced in a very wet period, say in winter time, and the coke was full of water; then the weighing was definitely misleading. Mr. Bunting proposed that a hearty vote of thanks be accorded to Mr. Bolton for his very interesting Paper.

MR. T. GOODWIN seconded the vote of thanks. He did not quite agree with one or two points, especially when it came to melting high percentages of steel, and he asked Mr. Bolton what blast pressure he would use for percentages in excess of fifty. The size of the cupola would be 42-in. internal diameter.

MR. BOLTON replied that blast pressure should be between 12-in. and 16-in. w.g.

Referring to one or two practical points, MR. GOODWIN said that if a high percentage of steel was to be melted successfully, it certainly could not be done at less than 16-in. w.g. One other very interesting matter raised by Mr. Bolton was that of leaving the slag hole open. He took it that once the slag hole was opened it remained open, but the blast pressure must be maintained at not less than 16 in. on the water gauge.

MR. BOLTON thanked the members for their reception of his Paper, which was intended mainly as an introduction to the discussion. In referring to the high bed mentioned by Mr. Bunting, he said he did not think there was any doubt that if they wanted high-temperature metal for high-quality castings, then a good bed height was necessary, and for the average foundryman it was easier to get a high metal temperature and consistent results with a high bed than with a low bed. Replying to Mr. Goodwin, he should have mentioned that if the slag hole were kept open, it was very important that it should be as small as possible. An open slag hole helped the cupola operator to take full advantage of the well capacity for the mixing of the molten metal and to some extent obviated the danger of flooded tuyeres, but the loss of air should be kept to a minimum.

American Foundry Sales

The index of sales of American foundry equipment during July rose to 194.4, as against 164.9 in June. The index, which is compiled by the Foundry Equipment Manufacturers' Association, is based on the average for 1937-38-39 as 100 per cent.

Distortion in the Heat-Treating of Meehanite Metal*

By T. E. EAGAN

Distortion experienced in the heat-treatment of either steel or Meehanite is a difficulty that can be held to a minimum only with proper handling. The purpose of this Paper is to present briefly some information on the theory of the problem, and to attempt to correlate this with practical experience. Meehanite castings when ready to be heat-treated must first be free from casting and machining strains. This phase of heat-treating will not be considered here.

In general it is conceded that the two major components that make up Meehanite are a matrix of 0.70 to 0.90 per cent. carbon, and a considerable quantity of graphite flakes. The percentage of combined carbon is usually controlled by the foundry in its choice of wedge value, etc. The amount of graphite and its distribution have been the subject of a number of Papers before the Meehanite Institute, so that it is unnecessary to go further into detail. However, calling the matrix pearlite and the flakes graphite, what happens to each when a piece is heat-treated?

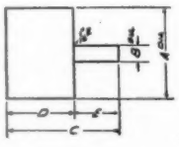
Irregular shapes will crack quicker than regular shapes because the thin sections absorb the heat faster, as a whole, than the thicker sections, and will be higher in temperature, thus tending to pull away from the thicker sections.

Therefore, it is always necessary to heat a piece of steel or Meehanite slowly and evenly up to 537 deg. C. Above that temperature, the great danger of cracking is eliminated, because the temperature gradient is reduced and because the material will have more ductility which will tend to even out the stresses caused by any uneven and quick heating.

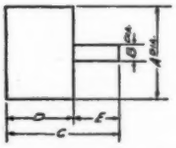
As heating proceeds, expansion continues up to a temperature of around 740 deg. C., when another phenomenon takes place. The piece suddenly commences to contract, but the temperature does not change. This is called the critical temperature of heating and is known as the AC_1 point. The amount of contraction can be as high as 2 per cent. of the length just before it passes into the AC_1.

After the casting has passed through this point expansion again takes place but at a higher rate so that, at room temperature, it is approximately the same size as before starting. Theoretically no distortion has been experienced. Now, instead of allowing it to cool slowly, suppose it is cooled rapidly from 870 deg. C. by quenching in oil or water. Things now happen differently. Because the piece is being cooled rapidly, the Ar does not take place at 740 deg. C. but much lower, at temperatures around 315 to 370 deg. C. If this were not true the piece could not be hardened. A study of this phenomenon is rather complicated, but it must be understood in order to portray the idea of the distortion.

On quenching, the surface of the piece cools rapidly to the Ar point, when it suddenly expands, this expansion being greater than that experienced in slow cooling. But because it is at so low a temperature the metal will not move as easily as it did at 700 deg. C., and this puts a compression stress in the surface layer. However, the layer immediately under this surface is at a higher temperature, and each successive layer is still higher, until at this instant the centre is at 870 deg. C. There is a very steep temperature gradient in the piece, and these underlayers, therefore, can deform to take the shape imposed on them by the surface layer, but they must also subsequently expand and push against this surface layer, putting it in tension and deforming it because the forces expended during this quenching operation are very high. They can easily be higher than the



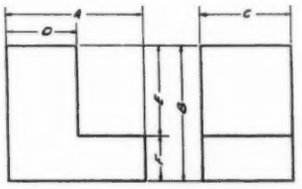
Dimension	Original Size	Change After Quench	Change After Draw	Total Change
A	1"	+.0055	+.001	+.0065
B	5/8"	+.0000	-.001	-.001
C	1 5/8"	+.0015	+.0005	+.002
D	1/8"	+.004	+.0000	+.004
E	⌐	+.0005	+.0000	+.0005

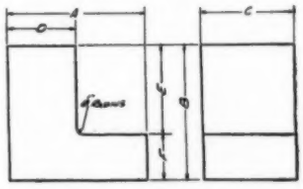


Dimension	Original Size	Change After Quench	Change After Draw	Total Change
A	2"	+.0055	+.0018	+.007
B	5/8"	+.0005	+.0005	+.001
C	2 5/8"	+.002	-.005	+.004
D	1 5/8"	+.004	+.000	+.004
E	1"	+.002	+.000	+.002

THE DIAMETERS WERE CONCENTRIC AFTER HEAT TREATMENT
HARDNESS BEFORE HEAT TREATMENT 226 BRINELL
HARDNESS AFTER QUENCH 2" DIA. 50 ROCKWELL C
5/8 DIA. 48 ROCKWELL C.
HARDNESS AFTER DRAW 2" DIA. 45 ROCKWELL C
5/8 DIA. 42 ROCKWELL C

FIG. 1.—DIMENSIONS OF PIECE EMBODYING ABRUPT CHANGES OF SECTION BEFORE AND AFTER HARDENING AND AFTER TEMPERING.





Dimension	Original Size	Change After Quench	Change After Draw	Total Change
A	3"	+.006"	+.001	+.007"
B	3"	+.006"	+.005"	+.011
C	2"	+.003"	+.001"	+.004"
D	1 1/2"	+.003"	+.001"	+.004"
E	2"	+.008"	+.0000	+.008"
F	1	+.002"	+.0000	+.002"

Dimension	Original Size	Change After Quench	Change After Draw	Total Change
A	3"	+.005"	+.004"	+.009"
B	3"	+.006"	-.002"	+.004"
C	2"	+.004"	+.002"	+.006"
D	1 1/2"	+.005"	+.001"	+.006"
E	2"	+.013"	-.001	+.012"
F	1"	+.002"	+.002"	+.004"

HARDNESS
AS CAST – 226 BRINELL
AS QUENCHED – 496 "
AS DRAWN – 415 "

FIG. 2.—DIMENSIONS OF PIECE, INVOLVING SHARP RE-ENTRANT ANGLES, BEFORE AND AFTER HARDENING AND AFTER TEMPERING.

Effect on the Pearlite

The pearlite is very similar to what is in a piece of tool steel, so correlation will be to a piece of 0.9 per cent. carbon steel of approximately the same composition as a Meehanite casting in the process of hardening. Upon introduction into the furnace, the piece begins to expand. The outer skin will be hotter than inner layers, so these outer surfaces expand more than the inner ones, tending to pull away from them. This difference in temperature is called the temperature gradient. Each layer, therefore, during this period is tending to pull away from the other layers beneath it. The tendency of this stressing or pulling will be in proportion to the speed at which the piece is heated. If it is sufficiently fast, one can actually crack the surface of the piece. Once the crack is started the whole piece is liable to break open. The more brittle the material the stronger the tendency for it to crack.

* A Paper which was presented before the Meehanite Institute.

than before, so that when it is at the hardening temperature the sample is approximately the same length as it would have been had it not passed through the contraction of AC_1. At 870 deg. C., the piece is larger than it was at room temperature. It is soft and plastic in comparison with its original state. It should be remembered that reference is being made to 0.9 per cent. carbon material, the matrix of which consists wholly of pearlite with no graphite present.

Cooling Conditions

Assume the piece to be cooled slowly; it will contract at a fairly rapid rate until a temperature about 640 deg. C. is reached, when it expands an amount equal to that which it contracted when heated through 740 deg. C., and the temperature remains constant until this expansion is complete. This is known as the Ar point. At this temperature the metal is ductile, so that it will accommodate itself to this expansion without putting any great amount of stress on the piece. In further cooling it contracts tensile strength of the material and break the bar into several pieces. Thus the very act of hardening tends to cause distortion, and it is only when close study is given to heating and quenching that uniform dimensions can be had.

Influence of Graphite

In Meehanite metal there is a second constituent, the graphite. When such a piece is heated above 540 deg. C. there is a tendency for the cementite in the matrix to break up into ferrite and graphite. This tendency increases with temperature and time, so that if the piece were held at 870 deg. C. long enough there would be nothing except iron and graphite, which would be accompanied by a marked increase in the dimension of the casting.

Another factor that will tend to change the size of the piece is the scaling action of the furnace atmosphere, and this scale removes a certain amount of the surface of the piece. The scaling of Meehanite is not so severe as scaling of steel, but if the atmosphere is not controlled properly one can experience trouble

in this direction. In brief, an atmosphere high in moisture and sulphur will scale very rapidly. Therefore, a gas- or oil-fired furnace may scale more than an electric furnace. The use of a controlled-atmosphere furnace will eliminate scaling completely.

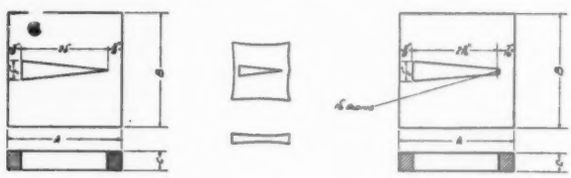
Thus there are four factors to consider:—(1) Natural expansion and contraction on heating and cooling; (2) expansion caused by the hardening operation; (3) graphitisation, and (4) scaling.

Reducing Distortion

This leads one into an unlimited field, which in the final analysis brings the question down to the one fact that each individual piece to be hardened presents its own problem and must be treated accordingly. There are, however, certain general rules which will help to minimise the distortion experienced. These may be divided into three categories. The first is the design, the second the method of heating, and the third the method of cooling.

Under design are grouped all rules regarding the shape and size of the piece. This is the most important feature in controlling distortion, because the control that can be accomplished in the heating and quenching depends entirely on the size and shape of the piece in question. There is only one rule in regard to design. A part is properly designed when the entire piece may be heated and cooled at approximately the same rate during the heat-treating operation. It is impossible to fulfil this rule absolutely. Even a sphere will cool and heat unevenly from the centre to the outside. One must, therefore, be content to design so that no two points in the piece shall have very great differences in temperature at any time during heating or quenching. This is, of course, the ideal situation; in practice it seldom can be reached. However, certain features should be avoided:—(1) Abrupt changes in section, such as shown in Fig. 1, which are almost always liable to cause trouble; (2) sharp re-entrant angles, such as shown in Fig. 2; (3) sharp corners (no piece should ever be heat-treated unless it has generous fillets), and (4) uneven spacing of holes. It is better to put more holes in the piece to give uniform spacing than to harden with uneven spacing. Furthermore, the holes should not be too close together; no general rule can be given, but it is rather risky to attempt hardening if the piece has holes with less than ¼ in. of metal between them.

Assuming that the piece is heated properly and uniformly before quenching, certain precautions used in the quenching operation should

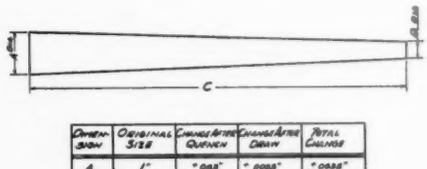


Dimension	Original Size	Change After Quench	Change After Draw	Total Change
A	3"	+.008"	+.0005"	+.0085"
B	3"	+.009"	+.001	+.010"
C	9"	+.021"	+.0030	+.024"

Dimension	Original Size	Change After Quench	Change After Draw	Total Change
A	3"	+.010"	+.001"	+.011"
B	3"	+.001"	+.005"	+.006"
C	9"	+.021"	+.003	+.024"

Hardness
as Cast — 226 Brinell
As Quenched — 52 Rockwell C
As Drawn — 43 Rockwell C

FIG. 3.—DIFFERENCES IN SHAPE OF A PIECE AFTER HEAT-TREATMENT.



Dimension	Original Size	Change After Quench	Change After Draw	Total Change
A	1"	+.003"	+.0005"	+.0035"
B	½	+.0015	+.002"	+.0035"
C	9"	+.028"	+.003"	+.031"

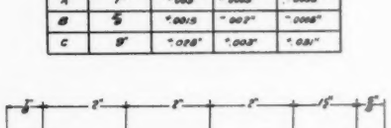


FIG. 4.—BEHAVIOUR OF A TAPERED PIECE.

be taken. The whole operation should be studied before quenching, and the following precautions taken:—

(1) Quench the piece so that the heaviest section of the piece enters the bath first. This will give the heavier section a start on the cooling before the thinner section gets started.

(2) Keep either the piece or the bath in constant motion.

(3) Quench so that there will be no chance of entrapping the quenching medium in pockets or holes.

(4) Remove the piece from the quenching medium between 150 and 260 deg. C. and temper immediately.

The avoidance of graphitisation is not difficult if published instructions are followed in using the correct wedge value according to the section of the castings, *i.e.*, the wedge should be at least one-quarter the average thickness of the casting, but even so it is important that the piece be got up to 870 deg. C. as quickly as possible and held only sufficiently long to soak through, which can be judged when the casting and the furnace blend into one colour.

In order to demonstrate what happens if the design of the piece is wrong, the author made up several pieces and hardened them, taking careful measurements before and after hardening and also after tempering. These are illustrated in Figs. 1 to 4 inclusive. As will be seen, an increase in size was experienced in every case. The tempering at 370 deg. C. was done to show how much of this was due to graphitisation, as 370 deg. C. will eliminate a majority of the quenching strains. All this material was well normalised before heat-treatment, so none of it can be attributed to the relief of strains in the piece before heat-treatment. It can be concluded, therefore, that in general the greatest amount of change in size is due to graphitisation.

In the shape shown in Fig. 2 there is a difference in the sum of dimensions, F and G, which should equal B. This indicates that this arm flared out, which should be expected. If the flaring had been great enough, the piece would

(*Continued in next column.*)

Corrosion of Steels by Molten Nitrates

In a Paper prepared for presentation to the Iron and Steel Institute, MR. P. LLOYD and DR. E. A. C. CHAMBERLAIN, covering the subject of "The Corrosion of Steels by Molten Nitrates," the authors have drawn the following conclusions:—

The corrosion of steel by molten alkali nitrate has been investigated with special reference to the effects of temperature and of impurities in the salt. It was found that the scaling which takes place under these conditions is different both in character and in extent from scaling in a gaseous medium at the same temperature. Although the rate of oxidation increases markedly with rise in temperature, local heating of a part of the metal container does not in itself give rise to abnormal scaling at that point. Exploratory tests on certain irons and steels showed that Armco iron had a high resistance to this form of corrosion; investigation of this aspect of the problem is continuing.

The protection provided by aluminium coatings was uncertain. Alkali chlorides are common impurities in the commercial salts used for the heat-treatment of light alloys, and it was found that they are responsible for a marked acceleration in the rate of attack on the steel; 0.1 per cent. exercises a considerable influence. It was found that decomposition of nitrate to nitrite does not proceed to completion, and that salt mixtures containing much nitrite are oxidised by the atmospheric oxygen. In one series of tests with sodium salts at 500 deg. C. and in air the equilibrium concentration of nitrite was found to be about 4 per cent. It is concluded that with the sodium salt the presence of 5 per cent. or more of nitrite should be helpful in suppressing the corrosion, but with the eutectic a greater addition may be necessary on account of the lower intrinsic dissociation temperature.

Gray Iron Founders' Society

Mr. C. J. Miller, of the Freemont Foundry Company, Freemont, Ohio, has been elected President of the [American] Gray Iron Founders' Society. Mr. W. W. Rose was re-elected executive vice-president.

(*Continued from previous column.*)

have cracked at the fillet. Note the shape of the piece after heat-treatment between the two drawings shown in Fig. 3. This is, of course, exaggerated, but such a condition may be expected with such a piece.

The length of the tapered piece shown in Fig. 4 has increased considerably. This is mostly due to graphitisation. It was hoped to show that the pieces with the sharp corners would crack in this corner and the ones with the fillets would not; however, such cracking was not experienced in either case. If they had been water-quenched instead of oil-quenched, they surely would have cracked. The oil-quench was not sufficiently drastic to cause that to occur.

A study of these figures will show that not one of them distorts in exactly the same way. This is an excellent illustration that each shape presents its own problem and must be studied as an individual entity. Somewhat different results are always expected from the same shape cast from different heats in the foundry. However, in general the distortion experienced would be in the same direction, but not of the same magnitude if the heat-treating procedure is exactly the same.

Ford Cast Crankshafts Poured Continuously*

By EDWIN F. CONE

The substitution by the Ford Motor Company (Detroit) of a cast for a forged steel crankshaft for its passenger cars several years ago was an event of broad metallurgical interest. Such a step, however, was not taken without mature consideration accompanied by extensive experimentation and research. Ever since the Ford Company initiated the production of a crankshaft of cast steel, one of the aims of that progressive organisation has been to develop the process from an intermittent to a continuous melting and pouring operation.

The continuous melting and pouring of cast iron is a different problem from that of handling the copper-silicon high-carbon steel for crankshafts. In the case of iron for Ford cylinder blocks, metal from the blast furnaces and cupolas is transferred to a mixer and from this to an electric arc furnace for superheating. Composition is easily regulated at this stage. From the arc furnace the metal flows into a forehearth, heated with powdered coal, from which it flows from each end to the continuous pouring equipment.

To develop a similar or better method for the crankshafts, the problem was one of economy as well as of metallurgical control. Since the advent of the steel crankshaft in 1933, the Ford metallurgical engineers have had it in mind to melt and pour the steel continuously.

Steps in Developing the Process

The first attempt was to use an air furnace, fired with pulverised coal, supplemented by a conventional cupola—cupola air-furnace manipulated metal. This did not prove entirely satisfactory, due to the fact that an oxidising flame had to be used in the air furnace in order to reduce the high carbon in the metal from the cupola. This oxidised metal was not of the best quality and the analysis was very difficult to control, especially when it is necessary to obtain a metal averaging 1.35 to 1.60 per cent. C.

The next attempt was made with an oil and steam-fired cupola which was provided with a small receptacle for holding a small bath of molten metal at the base. Due to the drastic impinging action of the flame on the refractories, this arrangement did not prove satisfactory. Metal made by this process, however, was better than in the first trial method.

From the experience thus obtained, the third and present method was developed. It was decided to build a furnace that would combine the stack charging and continuity of a regular cupola with the hearth and chamber similar to a pulverised-coal-fired air furnace. The flame from the combustion of the pulverised coal would sweep across the long bath in the hearth and on up the stack, thus preheating and partially melting the incoming charge.

The New Process

This theory has been carried out and put into commercial operation—the charge is put into the side near the top of a long cupola at the bottom of which is a long air furnace hearth. The products of combustion from the powdered coal, which enters the air furnace at the end farthest from the stack, sweep through the hearth and up the cupola stack—this equipment may be regarded as an air furnace with a long high stack which is used for supplying the furnace with partially melted metal.

* Slightly abridged from "Meta ls and Alloys."

The charge placed in the cupola stack can be depended upon to be the same as to composition as when charged—there are virtually no chemical reactions in the stack or furnace. The flame, sweeping across the hearth of the air furnace bath, melts the charge at the base of the cupola or stack, whence it then pours continuously into the hearth. A suitable stock yard is supplied with the raw materials from which the proportions of each material are selected, weighed and charged into the side of the cupola by a 1-ton bucket every 4 min. By means of a crane the 1-ton bucket is swung into the open door in the side of the cupola and dumped by opening a false bottom.

The Charge Used

Each charge consists generally of the following materials:—Return scrap (crankshaft), 40.0; basic pig (2 per cent. Si), 20.0; and briquetted borings, 40.0 per cent. This charge, as it melts at the base of the cupola and is further melted and brought up to suitable temperature in the air furnace or forehearth, has approximately the following composition:—C, 1.50; Si, 1.00; Mn, 0.80; Cu, 1.50; and Cr, 0.15 to 0.18 per cent.

Detailed data are not available as to the dimensions of this equipment, but the construction and dimensions are essential factors in the success of its operation. In general the forehearth slopes down toward the tapping spout but enough molten metal is continually in the hearth under the stack or cupola so that the incoming charges rest in molten metal.

The throat or base of the cupola or stack is so contracted or pinched in that the charges do not come down too rapidly. The size of the opening in this throat is of particular importance—too small a throat would cause the charge to pack up, thus decreasing the passage through which the products of combustion could escape. On the other hand, if it were too open, the flame could escape too easily, resulting in less efficient heating.

Specially-Built Cupolas

The diameter of each of the two cupolas or stacks is 36 in. Their total height is approximately 25 ft., with the opening or door for charging 15 ft. from the foundry floor level. The height of the forehearth above the foundry floor is about 10 ft. The roofs of the forehearths are arched and the lining of the arch and side walls is a mullite base brick. A high-density, high-fusion neutral clay brick is used to line the bottom. For lining the cupola or stack, firebrick is used with the throat lined with mullite brick. The amount of powdered coal consumed per ton of steel tapped from each hearth averages about 300 lbs. The capacity of each forehearth-cupola plant is about 15 tons per hr.

At the present time no attempt is being made to pour the crankshaft castings directly by means of a pouring car from this forehearth. This may be a possibility for the future. Instead the metal is tapped from the forehearths into 8-ton transfer ladles, its temperature being about 1,480 deg. C. The metal is then transferred to 15-ton electric arc furnaces where it is superheated to about 1,600 deg. C. During this brief period, analyses are made in the spectrographic laboratory, and alloy and other additions are made if any are necessary to bring the metal to the desired composition.

From the electric furnaces the metal is conveyed in transfer ladles to a rocking type of holding furnace, fired with powdered coal. From this the metal flows continuously at about 1,540 deg. C. into a pouring car similar to that used in the continuous pouring of cylinder blocks.[1] This pouring car, taking metal continuously from the holding furnace, pours simultaneously two moulds of four crankshafts each, the pouring temperature of the moulds being 1,480 to 1,510 deg. C. This is pointed to as eliminating all ladle men pouring on the line as was the case when pouring metal direct from a cold charge in electric arc furnaces.

The continuous supply of steel from the cupola-forehearth equipment, together with the holding furnace and the continuous pouring equipment, makes it possible to pour many more crankshafts per day as against the output by the older process which this displaces.

Present Composition of the Metal

There has been very little change in the composition of the crankshaft metal since that first made public.[2] The composition as announced in 1935 and that used at present as made public last January in a Paper[3] by McCarroll and Jeter before the local Detroit chapters of the A.F.A. and the A.S.M. are as follow: 1935 and (1940)—C, 1.35 to 1.60 (1.35 to 1.60); Si, 0.85 to 1.10 (0.85 to 1.10); Mn, 0.60 to 0.80 (0.70 to 0.90); S, 0.06 max. (0.08 max.); P, 0.10 max. (0.10 max.); Cu, 1.50 to 2.00 (1.50 to 2.00); and Cr, 0.40 to 0.50 (0.40 to 0.50).

The only changes at present in effect as contrasted with the inception of the crankshaft are a slightly higher manganese range and a higher permissible sulphur content.

This unique and highly interesting cupola-forehearth equipment is not only a metallurgical achievement of decided merit but is also another step in the general policy of Ford metallurgical engineers of melting and pouring castings continuously wherever possible. Continuous operations of this nature not only save time but also, it is claimed, produce more uniform castings because the metal for each casting is delivered at uniform temperature. Besides the cylinder blocks and the crankshafts, continuous pouring is also used in producing the centrifugally cast gear blanks,[4] passenger car transmission housings, and flywheels. In fact the entire Ford foundry is being revised and enlarged in order to go into volume production of cast steel tractor parts and other products.

REFERENCES.

[1] "Continuous Pouring of Ford Cylinder Blocks," "Metals and Alloys," vol. 6, Nov., 1935, pp. 299-302.
[2] "Story of the Ford Cast Crankshaft," "Metals and Alloys," vol. 6, Oct., 1935, pp. 259-263.
[3] "Cast-Steel Tractor Parts," "The Foundry," February, 1940, vol. 68, pp. 30-33, 86.
[4] "Metallurgical Story of the Ford Centrifugally-Cast Steel Gears," "Metals and Alloys," vol. 9, Oct., 1938, pp. 276-279.

Railway Freight Charges

INCREASE OF 6 PER CENT. ON DECEMBER 1

Railway freight charges and certain passenger fares are to be increased by 6 per cent. on December 1, it was announced by Col. Moore-Brabazon, Minister of Transport, in the House of Commons on October 23.

Speaking at a conference later, the Minister emphasised that after the war it was necessary that the railways should be self-supporting and healthy, therefore provision had been made that if charges increased, the charges should be passed on to the user of the railways. Charges had been increased by 10 per cent. in January. Wage increases of £11,000,000 and £6,500,000 had already been made. In addition, the railway companies had been subject to increases on the material side, such as coal, coke, iron and steel, sleepers and timber. The Minister added that, in his view, rail fares would not be increased for at least another nine months.

Manufacture of Ferro-Silicon in the Blast Furnace

RESULTS OF RUSSIAN INVESTIGATIONS

Over the past decade Russian investigators have devoted much attention to the manufacture of ferro-silicon in the blast furnace, in the course of which experiments have been conducted on varying scales and at different steelworks, as surveyed in a recent article in "Stahl und Eisen." K. BUTENKO has described in "Stal" certain experiments carried out at the Stalin steelworks on a blast furnace of 380 cub. m. inside volume, where, at the end of a five-year campaign, a trial to make ferro-silicon was run. The supply of lime being short, part of the lime requirements was covered by blast-furnace slag; the concentration of silica in the charge was raised to correspond to the specified silicon content of the final iron, while the deficit of iron in the ore was made up by the addition of silica-free turnings and scrap. The slag then contains only alumina from the coke ash and the gangue from the ore, but the proportions of lime and silica in the charge had yet to be so regulated that a slag conforming chemically and physically with the working of the furnace and the pig-iron was obtained. The quantity of slag formed is thus largely determined by the combustibility of the coke, its sulphur and ash contents, fluctuations in composition and the size distribution of the components of the charge. The normal slag yield at the blast furnaces of the Donetz basin is 450 to 600 kgs. per ton of pig-iron, the slagging components of the charge being raised to obtain this yield by the addition of silica and lime to the charge. In the ferro-silicon trial blast-furnace slag was added in place of these materials, and gave a better size distribution in the charge, improved gas permeability, and saved a certain amount of lime. This does not provide for the slagging of the sulphur in the coke, since the charge already contains a high proportion of sulphur; the author suggests, however, that with normal heating of the slag and uniform working conditions the slag is capable of taking up more sulphur than merely 5 per cent. CaS, owing to the absence of alumina and in spite of its high silica content. This was confirmed, for the ferro-silicon slag contained 8.82 per cent. CaS or 3.92 per cent. S.

Preparation for Change-Over

Before changing over to ferro-silicon the furnace was running stahleisen with 1.17 per cent. Si, 2.62 per cent. Mn and 0.05 per cent. S. At first, the iron ore was replaced by quartz sand and quartzite and open-hearth slag added, but two days later blast-furnace slag was introduced. For the production of 1,000 kgs. of ferro-silicon, the trial charge contained 13.5 per cent. siliceous iron ore with 43.2 per cent. Fe and 36.2 per cent. SiO_2, 9.3 per cent. open-hearth slag with 10.5 per cent. Fe and 25.2 per cent. SiO_2, 13.4 per cent. cinder with 51.6 per cent. Fe and 27.3 per cent. SiO_2, 10 per cent. broken castings, 15.2 per cent. steel scrap, 5.3 per cent. lime, 17 per cent. blast-furnace slag with 0.7 per cent. Fe, 37.2 per cent. SiO_2 and 40.7 per cent. CaO, 11.6 per cent. coke fines, 4.7 per cent. anthracite, and 1,408 kgs. coke to make up a charge of 3,587 kgs., with 845 kgs. Fe, 495 kgs. SiO_2, 136 kgs. Al_2O_3, 291 kgs. CaO, 25 kgs. MgO, 388 kgs. Mn and 301 kgs. S. The average throughput at the start of the trial was 69 charges and at the end 76 charges.

The ferro-silicon made contained 11.48 per cent. Si and 2.60 per cent. Mn, the sulphur content not being stated. The top-gas temperature at 670 deg. was only slightly lower than the air-blast temperature of about 700 deg. The top gas contained on an average 4.1 per cent. CO_2, 32 per cent. CO, 4.7 per cent. hydrogen, and 0.65 per cent. methane. The high hydrogen and methane values were probably due to the Russian practice of adding moisture to the burden to reduce dust losses. Slag analysis was practically the same as when making stahleisen, *viz.*, 31.6 per cent. silica (32.7 per cent. with stahleisen), 44.9 (47.8) per cent. CaO, 17.1 (12.9) per cent. Al_2O_3, 1.3 per cent. MgO (not determined), 0.76 (1.88) per cent. Mn, 0.20 (0.16) per cent. Fe, and 3.72 per cent. S (not determined). The aims of the trial were thus achieved, especially the saving in lime, in spite of the fact that the addition of slag to the burden can hardly be considered economical from a thermal standpoint.

Trials in Veteran Plant

Similar trials were carried out on a 930 cub. m. blast furnace at the Voroschilov works, according to a Paper in "Stal" by W. WORONIN and collaborators. Again here an attempt to make ferro-silicon was made just prior to blowing-out the furnace after a campaign of iron making. In a campaign of 4½ years, this furnace had produced 1.09 million tons of stahleisen, 158,000 tons of foundry iron and 16,000 tons of ferro-silicon. When the furnace was changed over to the manufacture of ferro-silicon the brick-work had become very worn, part of the cooling arrangements and several tuyeres were out of commission, the cup and cone were defective, and the hot-blast stoves in such a condition that the blast temperature could not be raised above 600 deg. Before changing over, the furnace hearth was washed down with hot acid slags of foundry iron. The raw materials used in this trial were coke with 11.2 per cent. ash, 4.5 per cent. moisture, 1.9 per cent. S and 0.94 per cent. volatiles, grade III Krivoi-Rog ore with 58 per cent. Fe, 14.2 per cent. SiO_2, 4.1 per cent. moisture, grade IV Krivoi-Rog ore with 46.5 per cent. Fe, 31.3 per cent. SiO_2, 3.1 per cent. moisture, grade II Tschiaturi manganese ore with 42.3 per cent. Mn, 18 per cent. SiO_2, and 0.195 per cent. P, welding cinder with 50 per cent. Fe and 30 per cent. SiO_2, and open-hearth slag with 10.5 per cent. Fe, 10.8 per cent. Mn, 24 per cent. SiO_2, and 36.5 per cent. CaO. The burden was prepared to obtain a slag index $(SiO_2 + Al_2O_3)/CaO = 1.1$ for ferro-silicon with 10 per cent. Si per ton of pig-iron; it comprised 19.1 per cent. grade III ore, 45.3 per cent. grade IV ore, 1.4 grade II Mn ore, 2.4 per cent. welding cinder, 1.6 per cent. open-hearth slag, 8.5 per cent. scrap, 21.7 per cent. lime, and 2,127 kg. of coke to make up a charge of 4,916 kg. Ferro-silicon was made in three stages; in the first the slag was sufficiently easy flowing and operations were interrupted when pig-iron commenced to run out of the furnace as the slag was tapped. In the second stage, a higher silicon was attempted by reducing the basicity of the slag, but the viscosity of the slag introduced difficulties in working. In the third stage, a high slag basicity was therefore again employed and a lower silicon in the pig-iron.

Analyses of the Products

The analyses of the products in these trials were as follow:—

Ferro-silicon No. I: 12.76 per cent. Si, 1.72 per cent. Mn, 0.139 per cent. P, and 0.013 per cent. S.

Ferro-silicon No. II: 14.05 per cent. Si, 1.38 per cent. Mn, 0.141 per cent. P, and 0.015 per cent. S.

Ferro-silicon No. III: 11.22 per cent. Si, 1.68 per cent. Mn, 0.139 per cent. P, and 0.015 per cent. S.

Slag No. I: 37.2 per cent. SiO_2, 10.5 per cent. Al_2O_3, 44.51 per cent. CaO, 1.66 per cent. MnO, 0.64 per cent. FeO, and 2.02 per cent. S.

Slag No. II: 42.8 per cent. SiO_2, 9.84 per cent. Al_2O_3, 40.70 per cent. CaO, 0.83 per cent. MnO, 0.73 per cent. FeO, and 2.06 per cent. S.

Slag No. III: 38.7 per cent. SiO_2, 9.76 per cent. Al_2O_3, 45.69 per cent. CaO, 0.77 per cent. MnO, 0.79 per cent. FeO, and 2.14 per cent. S.

The slags containing 41 and 47 per cent. CaO had the most satisfactory viscosities. It may be noted that the ferro-silicon was machine-cast, the losses being 4.4 per cent. in the ladle and 0.3 per cent. in the casting machine. Costs are analysed in the original Paper and amounted to 186.46 roubles per ton, which is regarded as an economic figure. Of this cost, 77.1 per cent. was absorbed by raw materials. The trial appears to show that it is economical to make ferro-silicon in a large blast furnace, although smaller furnaces are certainly better suited to the variable conditions which have to be maintained.

Theory Underlying Use of Enriched Blast

A pertinent subject to this question, *viz.*, the manufacture of ferro-alloys in the blast furnace using an oxygen-enriched blast, is discussed on a theoretical basis by M. A. SCHAPOWALOW in a Paper in "Teori. prakt. met." Dealing principally with charcoal furnaces employed in the Urals, the author concludes from experience gained with these furnaces that using an oxygen-enriched blast, a better reduction of silicon is obtained, enabling a ferro-silicon with 45 per cent. Si to be manufactured, the slag containing 9 per cent. Si and amounting to 700 kgs. per ton, thus ensuring a 94 per cent. Si reduction. If bauxite is used, a slag rich in alumina is obtained suitable for the production of aluminium. Examples are calculated for a blast containing 45 per cent. oxygen and for one with 60 per cent. oxygen. Also, if local clays are added, the author shows that with 60 per cent. oxygen in the blast a slag suitable for making aluminium is obtained in addition to the production of ferro-silicon. The process takes place in two stages; firstly, a ferro-silicon with 25 per cent. Si is made from ore, clay and lime, the slag then being remelted in a second furnace with iron ore, scrap and lime, which gives a ferro-silicon with 10 per cent. Si and the alumina-rich slag. It is noted that, in spite of the marked increase in oxygen content of the blast, the coke consumption is still of the order of 2,000 to 2,500 kgs. per ton of ferro-silicon. Although the treatment in this Paper is exhaustive, no practical evidence is given to support the conclusions drawn.

Rand Purchases

The Transvaal Chamber of Mines announces that purchases of castings for the last three years were of the following values (in £'s):—

	1939.	1938.	1937.
Brass	42,158	42,412	39,618
Iron	158,567	184,892	179,796
Al, Cu, etc. ..	3,085	306	410
Foundry requisites	1,351	1,233	1,023

As steel castings are not listed separately, it is assumed that they are included with "iron." The total purchases are just under £12,000,000.

British Cast Iron Research Association

ANNUAL REPORT FOR 1939-40

Although the year under review began before the war, the report for the previous year was presented after war had broken out, and contained some references to its influence on the work of the Association.

Council and Officers

The nineteenth annual general meeting was held in Birmingham on November 1, 1939, Dr. Harold Hartley presiding. The report and accounts were unanimously approved. The retiring President, Lord Dudley, was warmly thanked for his services, and was elected an honorary member. Lord Austin of Longbridge, retiring Vice-President, was unanimously elected President.

The Council re-elected Dr. Harold Hartley as chairman, with Mr. P. A. Abernethy and Mr. J. B. Allan as vice-chairmen. The war has naturally influenced the number of meetings during the year, and three meetings of the Council have been held. Dr. J. E. Hurst was re-elected chairman of the Research Committee, of which four meetings have been held, and Mr. T. M. Herbert, chairman of the Publications Committee, of which two meetings have been held. The A.R.P. Committee, of which Mr. P. H. Wilson was elected chairman, held four meetings. The Council appointed an Executive Committee, consisting of the chairman and vice-chairmen of Council, chairman of the Research, Publications and A.R.P. Committees, to take emergency decisions, and this has held six meetings, and now meets at intervals of about a month. The total number of meetings of committees and sub-committees held during the year is forty, including six meetings of the Anti-Glare Committee, to which further reference is made below. The committees and sub-committees and their membership are substantially unchanged.

The Council profoundly regret to record the death, in November, 1939, of Mr. J. E. Fletcher, who for many years was connected with the Association; in September, 1940, of Sir Harold Carpenter, and, late in the same month, of Sir Robert Hadfield, both of whom for many years represented the D.S.I.R. on the Council.

Research and Development

Of the group of investigations concerned with graphite formation, the experimental work of securing fine and super-cooled graphite structures from the cupola has been completed, although two reports are still awaited. The work on the estimation of non-metallic inclusions by chemical methods, in conjunction with the Iron and Steel Industrial Research Council, continues, and the aqueous iodine method now being employed on a wide range of British pig-irons can be checked for total oxygen by the aluminium reduction method. In an attempt to check the results of the chemical methods by microscopical examination, an exhaustive report has been prepared by Mr. H. Morrogh, giving the results of an examination of a wide variety of cast irons for inclusions, extending over a period of years, together with those on some cast irons specially prepared for the purpose. The work on ingot moulds in conjunction with the Iron and Steel Industrial Research Council continues with respect to the causes of cracking, and tests are in progress on small moulds for expansion and distortion under stress set up by molten metal. The mechanical properties of ingot mould metal at elevated temperatures are also being determined.

Conditions arising out of the war were foreseen to be likely to stress the importance of irons produced entirely from native ores, and some preliminary work was begun on phosphoric irons. Later, the subject assumed such importance that it was decided to concentrate on an extended examination of the properties of high-duty phosphoric irons, the staff hitherto devoted to studying shrinkage and contraction and fine graphite formation. Later, the Institution of Mechanical Engineers Research Committee on High-Duty Irons for Engineering Purposes approved of the study of high-duty phosphoric alloyed irons, so that there became available for this problem a team of workers able to deal not only with mixtures, compositions and mechanical properties of plain and alloyed phosphoric irons, but with their founding properties as well, and the work on the plain irons is now approaching completion. The Ministry of Supply has expressed its interest and its recognition of the national importance of this work.

The earlier work on shrinkage and contraction has reached a stage at which the results can be, and are being, applied to practice, with marked success. The original programme of the first part of the work on high-duty irons for the Institution of Mechanical Engineers has been carried out and the second report is in draft. For the information of engineers and designers, monographs on austenitic and martensitic cast irons are also in preparation.

The Joint Committee on Vitreous Enamelling, under the chairmanship of Mr. W. Todd, of the Association and the Institute of Vitreous Enamellers, has been active, having held six meetings, and the first of its sub-committees, with Mr. J. W. Gardom as chairman, has energetically completed its programme. A standard test for acid resistance of vitreous enamel has been agreed on, and a test for ware *in situ* has also been evolved. Work on tin oxide as opacifier has also been begun for the International Tin Research and Development Council and continues. As stated in the last report, priority requirements for aluminium compelled the closure of the work on Cralfer aluminium cast irons.

The work on sands and refractories through the Joint Committee of Sand Testing has been held up on account of the general difficulty in holding meetings, but the section dealing with standard test-pieces and standard testing appliances is nearing completion. Work has also been done in two main directions, the first dealing with alternatives to present supplies of core sand for oil-sand cores, in connection with which a report has been issued to members, and the second with the recovery and re-use of sand from oil-sand cores.

The work on welded cast iron proceeds slowly, on account of the preoccupation with other work of the group of members who undertook before the war to weld plates cast by the Association for trial.

Of minor investigations, some work has been done and a report has now been issued on the use of briquetted ferro-alloys, and a further report on the use of ferro-alloys in general in the foundry is in hand. Some work has been done for the International Tin Research and Development Council on the effect of tin in cast iron, which incidentally necessitated working out an improved method for the determination of tin. This will be of value if under war conditions tin-bearing scrap is used for production work. A number of minor problems arising out of war conditions are being dealt with, but the above serves to indicate the changes brought about in the research and development programme.

Development Department.—The Development Department has been very heavily engaged on work arising out of anti-glare, and in addition, has dealt with 1,645 inquiries from members, compared with 1,540 for the previous year. These figures include only matters requiring considered advice, experiment or test, and do not include telephonic or postal inquiries which can be dealt with at once.

Laboratories.—The laboratories at headquarters and at Falkirk serve the requirements both of research and development, and the increase in some directions is considerable. No fewer than 19,745 estimations were made in the chemical laboratories, an increase of 50 per cent. over the previous year, and 1,521 examinations in the microscopic laboratories. The sands and refractories laboratory carried out over 2,000 tests, and the mechanical testing laboratories 5,189 tests, another increase of about 50 per cent. In the experimental foundry 515 melts were made.

Scottish Laboratory.—The returns for the Scottish Laboratory at Falkirk are included in the above figures, but this laboratory has shared fully in the increases recorded. Mr. P. A. Abernethy (vice-chairman of Council) and Mr. G. A. Ure (chairman, Scottish Committee) advise on emergencies in the absence of meetings of the Scottish Committee.

Library and Information Bureau.—In spite of difficulties relating to certain foreign periodicals, the number of library accessions and loans is only slightly less than the previous year at 443 and 1,793 respectively. In addition, 320 inquiries were dealt with.

Plant and Equipment.—The equipment of the laboratories has been materially improved during the year, and additions include a 50-ton universal testing machine, a 10-ton testing machine, several hardness testing machines, impact tester, and extensometers. The foundry has also been equipped with a 15-k.v.a. high-frequency furnace, capable of melting up to 15 lbs. of iron or steel. The vitreous enamelling laboratory has also been equipped with apparatus for the preparation and application of enamels, much of which was specially designed to correspond with works practice. The laboratories are approved for tests on metals by the Aeronautical Inspection Directorate (A.I.D.), chemical, microscopical and mechanical, and this is frequently a great convenience to members. The equipment of the Scottish laboratory has also been greatly improved. An existing testing machine has been replaced by a 25-ton machine, a 2-ton machine has been installed, together with equipment for hardness tests, microscopic examination and sand testing.

Staff.—Staff changes during the year include the release of three members of the junior staff to join H.M. Forces, and the departure of Dr. A. L. Norbury and Mr. J. W. Bampfylde, both of whom are now attached to the Research Department, Woolwich. Provision has been made for the protection of the staff during air raids. Twenty members of the staff are engaged in some form of voluntary part-time activity, such as A.R.P., A.F.S., Home Guard or first-aid services. The whole of the specialists on the staff are registered on the Central Register of the Ministry of Labour and National Service, but, as explained in the last report, the Association continues to function as an organised scientific unit and central scientific agency for the industry.

Reports and Publications

The "Bulletin" and "Enamelling Abstracts" have been issued regularly at quarterly intervals. Seventeen external reports have been listed in the former during the year, of which ten have

been Papers presented by members of the staff to scientific bodies. Ten translations of important foreign Papers have been made for the use of members. In addition, eight Series A (printed) Association Reports have been issued to members, and seventeen Series B (typescript) Reports have been made available on request. Four reports have been made available generally to the industry as Special Publications, including two on the prevention of glare from cupola furnaces. Furthermore, two reports have been issued as Special Publications by the Joint Committee on Vitreous Enamelling, as well as the recommended method for testing the acid resistance of vitreous enamel.

For some time past Special Publication No. 1, "Recommended Methods for the Sampling and Analysis of Cast Ferrous Metals and Alloys," has been out of print. The Tests and Specifications Sub-Committee and Publications Committee have arranged for a new edition, now in the Press.

Finance and Membership

The year under review is the first of a new five-year period with respect to grant aid from the Department of Scientific and Industrial Research. As explained in the last report, the Association is now required to obtain a subscription income from the industry of £8,000 per annum instead of £7,000 per annum in order to earn a block grant of £5,000. As in the previous five-year period, the industry is encouraged to increase the income by the offer of an additional sliding-scale grant of £250 for each £250 received from the industry over and above the first £8,000, up to a further limit of £3,500 per annum. Thus a total income of £20,000 per annum is possible from industrial subscriptions of £11,500. For the year under review certain grant-earning contributions lapsed on account of work suspended as a consequence of the war, with the result that the total grant-earning income showed little increase, and hence income from subscriptions plus grant was lower by the diminished grant, amounting to £1,000. Other income, however, was well maintained, and the total income was £17,910, compared with £18,212 for the previous year. The total expenditure was £19,000, showing a balance of expenditure over income of £1,090, compared with a credit balance for the previous year of £1,016. The difference, however, is almost wholly due to heavy capital expenditure on plant and equipment, amounting to £2,429, and provided out of revenue. Further reference to this is made elsewhere. In addition, over £400 was expended in materials in order to provide against possible shortage, and the sum of £425 was transferred to the Building and Equipment Fund, which now stands at £6,112.

The warmest thanks of the Council are due to the following for contributions to the Building and Equipment Fund during the year:

	£	s.	d.
W. & T. Avery, Ltd., Smethwick ..	105	0	0
Samuel Denison & Son, Ltd., Leeds	16	16	0
J. J. Habershon & Sons, Ltd., Rotherham	6	6	0
Horsehay Co., Ltd., Horsehay ..	4	10	0
Mirrlees Watson Co., Ltd., Glasgow	31	5	0
Metters, Ltd., Sydney	35	0	0
H. V. McKay Massey Harris Pty., Ltd., Melbourne	21	0	0
Parsons Marine Steam Turbine Co., Ltd., Wallsend	5	5	0
Tangyes, Ltd., Smethwick	10	0	0
John Williams & Sons (Cardiff), Ltd., Cardiff	5	5	0

Membership.—At the close of the year the number of ordinary and trade members was 359 and associate members 51, a net increase of six over the previous year.

Relations with Other Bodies.—These continue normally, and the representatives of the Association on other bodies are substantially unchanged.

Influence of the War

Reference has already been made to the influence of the war upon meetings held, and to the formation of the Executive Committee. The Council and Publications Committee will meet at least twice, and the Research Committee four times, a year. The director keeps in close touch with sub-committee chairmen, and meetings are held as needed. So far as the research programme is concerned, reference has also been made to work on high-duty phosphoric irons, and to work on economy in the use of silica sand.

Anti-Glare.—The Association was officially approached before the end of 1939 to constitute an Anti-Glare Committee, on which the Ministry of Home Security would be represented, for the purpose of assisting both the industry on the one hand and the authorities on the other, to meet the requirements of the defence regulations. The Civil Defence Act requires foundries working in black-out periods to avoid glare and offers a grant of 50 per cent. of the cost of approved schemes, the approval being entrusted to the Anti-Glare Committee, of which the Director is chairman. The amount of work involved in these schemes may be judged by the fact that since war started about 1,500 inquiries have been received and that schemes have matured or are maturing for over 300 firms, concerning some 700 furnaces, mainly cupolas. The first report on A.R.P. for cupola furnaces was circulated to members before the middle of 1939, and this was subsequently enlarged and issued as Special Publication No. 4 in October, 1939. Some 2,000 copies of this have been issued. At that time no knowledge or experience of the problem had been obtained, and a second report, which was issued to members in May, 1940, and published later as Special Publication No. 6, "Anti-Glare Equipment for Cupolas," was widely circulated in the industry, to Government departments and local authorities. Foundries now have a choice of some half-dozen types of equipment for screening the top of a cupola. The Ministry of Home Security issued, in December, 1939, a circular to all foundries on a list prepared by the Ministry of Supply, and the Association a further circular in April, 1940, explaining the responsibilities of foundries under the Civil Defence Act, and procedure. The fixing of July 31, 1940, as the final date for the receipt of schemes for approval greatly intensified activity. The Council desire to make it clear that the work done on anti-glare, for which no payment or return in any form is received, was undertaken in part because no other body in the country appeared to be in a position to deal with the matter, and because it is the policy of the authorities to work through recognised bodies. It was thought that the Association, from its knowledge of the industry, could aid works in meeting defence needs with a minimum of inconvenience and cost, and at the same time give a maximum of satisfaction to the authorities. Letters received indicate that the work has been greatly appreciated. In this work, as in all other problems in which the cupola is concerned, it has been found necessary to consider each furnace and each scheme on its merits, and no cut-and-dried solution is practicable.

Extended Uses of Cast Iron.—Shortly before the outbreak of war, on the initiative of the Association, there was convened at York a meeting of representatives of various sections of the ironfounding industry. From this meeting there resulted the formation of a group which subsequently became the Ironfounders' National Confederation, of which the Director acted as secretary until permanent officials were appointed.

The Association, which is concerned with increasing the sphere of application and extending the range of cast iron materials, continues to urge its wider use for defence purposes, and is actively co-operating with the Service departments. The attitude of these and other Government departments has been sympathetic, although developments have been delayed in part by the general situation in relation to raw material supply, and in part by the war situation as a whole. Nevertheless, a number of components are now being made in cast iron and malleable cast iron for direct war purposes. In addition, a considerable amount of work has been done in extending the use of high-duty cast irons to relieve pressure on the production of steels and non-ferrous metals. Broadly speaking, malleable foundries and engineering foundries have been fully engaged, but light-castings foundries have not yet been able to replace their normal peace-time volume. Efforts have also been made to extend the use of cast iron for A.R.P. trench linings, and for building purposes.

In general, the Association has been in active touch with all the Government and Service departments concerned with materials, with the object of extending the uses of cast iron.

Technical Advisory Committee. — The Director acts as a member of the committee set up by the Director of Iron Castings of the Ministry of Supply Iron and Steel Control to advise on problems arising out of raw material supplies to foundries. Dr. J. E. Hurst and Dr. A. B. Everest, well known to members of the Association, are also members.

Conclusion

The Council draw special attention to the fact that in the Association the industry possesses a team of specialists and experts covering every aspect of foundry practice and production, aided by all necessary laboratory staff, equipment and accommodation. The assistance normally rendered to members as a consequence of their subscription can be of great assistance under war conditions. Those firms in the industry who do not support the Association are reminded that subscriptions are recognised by the Inland Revenue authorities as business expenses for income tax purposes, and under present conditions this is of special value.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

523,965 WILLIAMS, W. S. Cast ingot moulds.

523,971 HARRIS, H. H. Conveying-mechanism, in particular for furnaces.

523,994 SCHLOEMANN AKT.-GES. Plant for rolling thin metal sheets.

524,075 MULLER, G., and WAGNER, H. Apparatus for separating iron from foundry and casting-cleaning residues.

524,179 GREENWOOD & BATLEY, LIMITED, and MACLAGAN, J. C. M. Cold-forging machines.

524,198 MARTIN, K. Pressure-casting furnace, especially for bearing metals.

524,201 INLAND STEEL COMPANY. Steel.

524,248 MALLORY METALLURGICAL PRODUCTS, LIMITED (Mallory & Company, Inc., P. R.). Production of alloys.

525,709 GENTIL, H. L. Metallurgic furnace.

523,785 TIGERSCHIOLD, K. M. Metallurgical apparatus operated by electrical induction.

523,823 SHORTER PROCESS COMPANY, LIMITED. Method of and apparatus for heat-treating metal bodies.

523,896 VANDERVELL, G. A. Manufacture of composite strip bearing-metal.

Application of Controlled, Directional Solidification to Large Steel Castings

By J. A. DUMA and S. W. BRINSON, Portsmouth, Va.

(*Continued from page* 272.)

The phenomenal strides which welding technique has been making for the past several years have won for it a permanent place in nearly all the metal-working industries. Conservative designers and engineers are acknowledging it to be an invaluable tool, not only for minor repairs of surface defects, but for the construction of metal assemblies. There is now scarcely a single steel foundry without a welding shop.

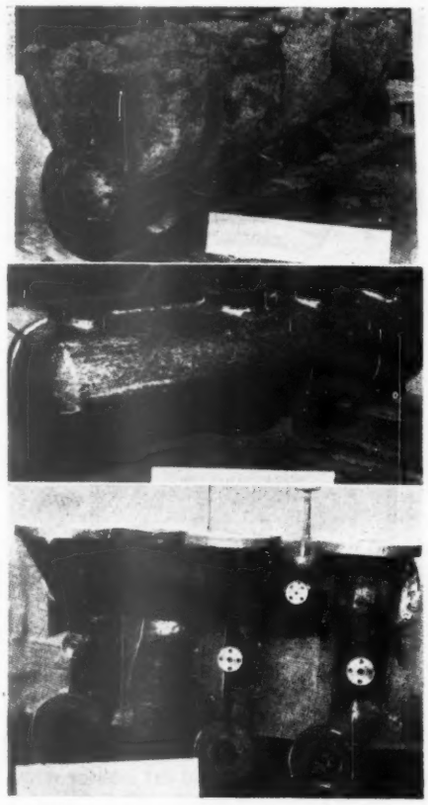


FIG. 21.—TOP: C-MO THROTTLE-VALVE BODY, AS CAST, SHOWING PARTING, MULTIPLE GATES AND RISERS. CENTRE: SAME CASTING WITH RISERS AND GATES BURNT OFF; BOTTOM SIDE FACING FRONT. NOTE PADDING STARTING FROM ZERO ON BOTTOM, AND RUNNING ¾ IN. DEEP AT MIDDLE (PARTING LINE). PADDING ON OPPOSITE SIDES RUNS SLIGHTLY OVER 1 IN. DEEP. BOTTOM: C-MO THROTTLE-VALVE BODY, SHOWING WELDED ASSEMBLY.

Not infrequently, the foundryman is asked to cast a structure the design of which defies every attempt to control the direction of its solidification. Throttle-valve bodies are an outstanding example of such a design. Since the chemistry of the castings mentioned herein is one which lends itself quite readily to welding, the most economical method, and sometimes the only method, whereby a sound condition of structure can be obtained in these complicated designs, is to dissect them into several more simple and elementary sections, cast each individually, and then unite them by welding. This is precisely what was done to the throttle-valve shown in Fig. 21.

It is seen that all the steam inlets were cast separately. The front and back plates, seats, brackets and nipples were cut from C-Mo plating. Regarding the body proper, it was made solid by means of four parting gates, 130 lbs. of outside padding (Fig. 22), and eight bulky risers (6 in. by 10 in. by 11 in.) covered with anti-piping compound. Hot tearing was avoided by making the body and its component parts in green-sand moulds and using cores made from oil sand topped off with green steel facing sand. Fig. 21, top and centre, shows the extent of heading and padding respectively.

Welding was performed in the flat position using $\frac{3}{16}$-in. and ¼-in. dia. electrodes and 150 to 250 deg. C. of oxy-acetylene pre-heat. Joints were veed to a 45 deg. bevel with a root spacing of ¼ in. and were backed up with a machined backing ring. Deposition was effected layerwise, using a weaving technique. The branches were welded in position one at a time. All welded joints were then X-rayed for soundness and the entire assembly stress-relieved at 675 deg. C.

The moulding materials and the amount of metal used in the various components of this structure are shown in Table X.

The latest practice has succeeded in making sound throttle-valve bodies with some of the branches integrally attached to the body. The throttle valve of Fig. 23 was made in such a manner. It is apparent that only half of the branches, *i.e.*, either all the upper or all the lower flanged sections, are integrally castable. The flanged sections were made in the cope. The T-shaped bosses, which are evident in the picture, were made to provide a seat for subsequent weld attachments. Integral castings cost approximately £25 to £30 less, and can be made in approximately two weeks less time than those put together by welding.

Other important castings, which are being cast in sections and welded together into composite structures, are certain types of turbine casings and possibly lower turret track ring sections. Thermit welding is being contemplated as a method for joining the latter.

Turret-Track Ring Sections

Turret-track ring sections have been made solid by applying directional solidification principles to them in the manner illustrated in Figs. 24 and 25. Careful study of the casting will identify the following points of practice as being instrumental in obtaining the desired temperature gradient:—(1) Positioning the lighter portion (the face) of the track in the bottom of the mould and the more massive parts directly over it; (2) chilling the bottom corner sections with chill nails (3 per sq. in. and extending into the mould cavity 2 in.); (3) denser nailing of the bottom surfaces of both core and mould; (4) light padding on one of the upper vertical members; (5) employment of massive risers and their top-pouring; (6) step gating—though not used on the section pictured in the photograph—is being contemplated for use on subsequent castings. Both the mould and all cores were made of sand-blast sand No. 5*c* mix (Table I).

Controlling the Direction of Freezing with Preheating of the Cope

Because of certain practical difficulties, the use of preheating on the cope to retard the chilling of feed-heads, and thus increase feeding efficiency, has not been tried on any large casting. It is mentioned in this discussion as a possible method, for it is not entirely impracticable, providing the proper facilities are available.

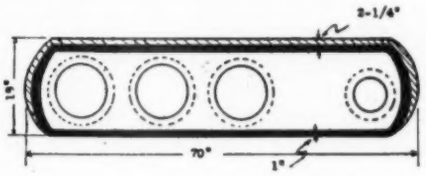


FIG. 22.—SECTION THROUGH MIDDLE OF THROTTLE-VALVE BODY AT RIGHT ANGLES TO THE HOLES. CROSS-HATCHING REPRESENTS PADDING.

In conclusion, it is stated that much has been done to obtain sound castings. There remain, however, many refinements to be made. Quantitative information is needed regarding the amount of padding and the size of external and internal chills to be used.

FIG. 23.—THROTTLE-VALVE CASING, SHOWING CASTING WITH INTEGRALLY ATTACHED BRANCHES.

APPENDIX I

An examination of the data contained in Table I discloses the following facts:—

Green Sand

(*a*) Air-drying increases the permeability as well as the compression and shear strength of green moulding sands.

(*b*) Air-drying for periods in excess of 60 hrs. affects disadvantageously their physical properties. Skin-drying with a gas torch, however, nullifies the deteriorating effects of setting or drying time. Specimens air dried for 120 hrs.

TABLE X.—*Data on Throttle-Valve Body Casting.*

Moulding materials.		Weight distribution.			
Facing sand	Nos. 1*c*, 1*d* (Table I)	Weight of body, with risers and gates	3,198 lbs.	Outside padding	130 lbs.
Backing sand	No. 4*a* (Table I)	Weight of finished body	1,688 lbs.	Weight of components, branches, etc.	1,177 lbs.
Cores		Risers and gates	1,440 lbs.	Entire welded assembly	2,865 lbs.
Upper halves	No. 1*d* (Table I)				
Lower halves	No. 7*d* (Table I)				

and then torch-dried have physical values equal to those dried for 1 hr. at 105 deg. C.

(*c*) Spraying the moulds with molasses water for the preservation of the surface does not deleteriously affect the moulds. Permeability, or the ability of a mould to vent its gases, is lowered by approximately 6 to 8 per cent.

Dry Sand

(*a*) Drying at 260 deg. C. is productive of the highest physical properties in the sand.

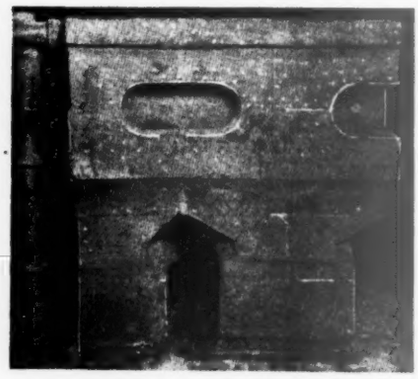


FIG. 24.—SECTION OF TURRET TRACK, AS CAST, WITH RISERS AND GATES ATTACHED.

(*b*) At least an 8-hr. sojourn at the drying temperature is required for good results.

(*c*) Washing the moulds with silica wash exerts a pronounced choking effect upon their permeability. Breathing efficiency is lowered by approximately 60 per cent.

(*d*) Dry moulds deteriorate rapidly if allowed to set too long (24 hrs. and over). Their compressive and shear strengths are reduced 50 per cent. or more.

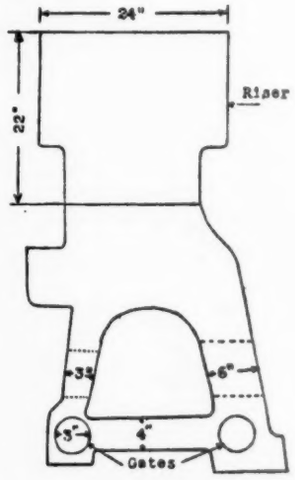


FIG. 25.—FRONT VIEW OF TRACK SECTION.

Cores

(*a*) A temperature of approximately 232 deg. C. appears to be best for baking cores.

(*b*) Spraying cores with linseed oil tends to increase their physical properties without adversely affecting their permeability.

(*c*) Washing cores with silica wash destroys their permeability.

(*d*) Prolonged exposure to air, of sand-blast sand cores, after baking, does not damage physical properties. Exposure of No. 60 oil-sand cores, however, is accompanied by slight impairment of physical properties.

(*Continued in next column.*)

Health Insurance Benefits

Insured persons should note that as, under Health Insurance, sickness and disablement benefits for 1941 are determined by the contribution totals registered in the contribution year ending June 30, 1940, cognisance should be taken of the expiry date of the period of grace which allows a person in arrears to liquidate those arrears. This period ends on November 30, and the persons concerned are ordinary voluntary contributors (meaning those insured under the combined scheme—Health Insurance and Pensions together—and also separately for Health Insurance), and also all employed contributors. The person concerned can bring up a contribution total to any number he desires, always remembering that the higher the total finally registered, the better the benefit rates for 1941.

To secure full benefits a total of fifty contributions must be recorded; if the total is smaller, reductions are made, the amounts being on a sliding scale (groups 36, 39, 42, 44, 46, 48), ranging from 1s. 6d. to 9s. for sickness benefit, and 6d. to 4s. 6d. for disablement benefit. If the total is under 36, no sickness or disablement benefit can be drawn in 1941. For any of these totals sickness weeks properly proved count for voluntary contributors, and sickness and unemployment weeks count for employed contributors, the same as actual payments.

Arrears are payable on arrears cards, the stamps for the combined scheme, voluntary contributors and employed contributors, costing 1s. 8d. for men and 1s. 2d. for women. An elderly contributor (meaning a man who at 60 or a woman at 55 had then completed ten years' insurance) can liquidate arrears for health insurance, by reduced rate stamps, those for men costing 9d. and for women 8½d. That is for any arrears over 26; to complete a total of 26, full rate stamps must be used. Voluntary contributors insured separately for health insurance use stamps costing 9d. for men and 8½d. for women. Voluntary contributors, however, should note that unless a total of 45 is recorded each year, the right to continue in voluntary insurance ends, although an elderly contributor can continue with 26 a year; both totals of 26 and 45, however, would be subject to the arrears rules above.

Lighting in Factories

The Minister of Labour has decided to give effect to recommendations of the Departmental Committee on Lighting in Factories which were published three months ago. Draft proposals have been sent to employers, who will have the opportunity of stating objections before the operative regulations are made.

(*Continued from previous column.*)

Summary

The most outstanding findings discovered by the above tests are:—

(*a*) Dry steel facing sands deteriorate rapidly with setting or prolonged exposure to air. This is the principal reason for the failure and burning down of the cope in anchor shank and anchor crown moulds. Dry-sand moulds should be poured within 12 to 24 hrs. after drying.

(*b*) Green-sand moulds do not deteriorate with time providing their surface is stabilised by torch-drying before closing-up.

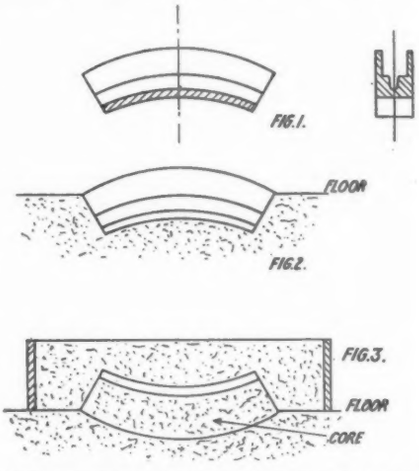
(*c*) Silica mould and core washes are to be used lightly and as sparingly as possible. They choke up cores and moulds and thus obstruct the expulsion of whatever gases are generated within them.

(*d*) Spraying green-sand moulds with molasses water, and cores with linseed oil, does not harm either the physical properties or permeability.

Some Jobbing Foundry Experiences—X

By "TRAMP"

Chain wheels can be made in a variety of ways, and large ones are often built up of segmental castings. Fig. 1 illustrates a typical segment, the making of which presents an interesting problem to the jobbing foundry undertaking the work, especially as the type illustrated was outside the normal range and the pattern supplied was a replica of the required casting. Lack of suitable box parts for moulding by the turnover method increased the difficulty. After consideration it was suggested that the job be moulded in the floor, a top box carrying the interior as shown in Fig. 2. This was found to be impracticable as the top lift was comparatively deep and only a minimum of taper was permissible. However, an attempt was made, with indifferent results, as invariably the pod of sand forming the interior would "tear down" when the top box was lifted, it being almost impossible to lift the box steadily enough for such a height. Securing the pattern to the top box and subsequently removing it



helped somewhat, but the job was still far from satisfactory, chiefly owing to the absence of sufficient taper inside to remove the pattern easily.

The following method was ultimately adopted, and a successful job made of the segments comprising this wheel. Temporary ends were fastened to the pattern, and the interior rammed and turned out on to a prepared sand bed and dried in the stove. After drying it was rubbed down so as to suit in the position it was originally rammed, and blackwashed. A bed being made in the floor, the pattern with the improvised core was placed in the position shown in Fig. 3, and sand was tucked around them holding both the pattern and the core in place. A top box was then rammed up. The pattern being secured to the top, it was lifted clear of the core and easily withdrawn from the mould. After cutting runners and risers the top was returned to its correct position and the job cast, the taper ends holding the "core" in place and securing it against lift. This is an instance of a dry-sand core in a green-sand mould, both mould and core being made off one pattern, without the use of a separate core box.

THE ADDRESS of the United Kingdom Ferro-Manganese Company, Limited, is now Radford House, Radford Semele, near Leamington Spa.

REPRESENTATIVES of the engineering unions are to meet the Employers' Federation in London on November 5 to receive the employers' reply to the claim for increased wages.

For High Quality Castings

The increasing demand for high-strength close-grained iron castings calls for improved metal. In comparison with the accepted standards of the past, the modern high quality casting requires lower total carbon and phosphorus, with a closer range in silicon. The Ironfounder can now meet this demand at a reasonable cost by the use of Stanton-Dale Refined Pig Iron.

Stanton-Dale is a pig iron of low total carbon, the graphitic carbon being uniformly distributed and of fine curly-flake formation. The close structure ensures remarkably high strength with good machineability, and Tensiles of 16 to 20 tons can readily be obtained when a proportion of Stanton-Dale Iron is introduced.

The use of this iron avoids the irregularities in structure which are sometimes observed when steel scrap has formed part of the charge.

The correct grade of Stanton-Dale Iron to use depends on the type and class of castings to be made. The Stanton Technical Service is available to advise on suitable mixtures.

Total Carbon from 2.6 per cent. upwards. *Analysis to individual specification as required.*

STANTON-DALE
REFINED PIG IRON

The Stanton Ironworks Company Limited, Near Nottingham

The Largest Producers of Foundry Pig Iron (for Sale) in Great Britain

Methods of Producing Steel for Castings*

AMERICAN STUDY OF RECENT PROGRESS

The A.F.A. Committee on "Methods of Producing Steel for Castings" has made a study of developments in the production of steel for castings during the past year, but it has revealed no revolutionary innovations, although it has shown considerable interest in the further development of new methods and the revival, under new conditions, of methods temporarily in disfavour.

Cupola-Converter

A conspicuous example of this is the increasing interest shown in the use of the cupola as an adjunct to the steel foundry and of the converter either for making finished steel or duplexing in combination with an electric open-hearth furnace.

Three new developments have combined to make the cupola-converter process much more attractive than was formerly the case. The first of these is the hot-blast cupola, which enables an all-steel scrap charge to be melted and attain a high temperature in the molten metal. This allows great flexibility and an independent swing from iron to steel or *vice versa* in the charge to take advantage of the market conditions.

The second is the further development of the soda-ash treatment of the molten iron for the removal of sulphur. This removes one of the principal objections to the use of cupola iron, especially where acid steel is made. An example of what can be done in sulphur removal was given in a private communication. Cupola iron which averaged 0.158 per cent. S in samples taken from the spout was treated with soda ash. The average of eleven ladles showed a content of 0.042 per cent. S after treatment.

A Paper on the "Desulphurisation of Pig-iron with Calcium Carbide," by Wood, Barrett and Holbrook ("Metals Technology," December, 1939) indicates the possibility of lowering the sulphur to contents of less than 0.02 per cent. or to contents much lower than is feasible with the use of alkalis.

Electric-Eye Control

The third is the adaptation of the photo-electric cell to the automatic control of the "blow" of a converter. This device is said to have great sensitivity and to be capable of stopping the blow at a precise carbon content, thus giving the highly desired control of composition.

Tests made have been reported so favourable that the next year should see some installations of cupolas to supply hot metal for open-hearth furnaces. The advantages are obvious in utilising a cheaper charge, in utilising the highly efficient cupola for melting and in increasing the capacity of the open hearth by shortening the time of a heat.

Electric Furnaces

Penton's Foundry List for 1939-40 (published in "The Foundry," July, 1939) shows an increase of 10 electric steel foundries in U.S. for 1939 over 1937, or 215 in all. Cone in "Metals and Alloys," September, 1939, quotes one engineer conversant with trends in the electric steel industry as saying that more large electric furnaces are being installed and are likely to be installed than ever before. The tendency will be to produce in the electric furnaces some alloy steels now made in the open hearth because, it is claimed, the trend in the cost of electric steel is downward. Contrary to this, the scrap and power situation led F. A. Melmoth in "The Foundry," January, 1940, to risk a prophecy that, "assuming the price spread of scrap and pig-iron is maintained as at present, and power costs experience no reduction, a return to popularity of the converter as a melting medium for many steel castings may be confidently expected."

An electric Tropenas furnace for alloy steels was described in THE FOUNDRY TRADE JOURNAL, December 28, 1939, page 448. In this apparatus the base steel of very low carbon content is first prepared by regular converter methods. Then a section of the furnace is removed and super-heating is accomplished by application of the electric arc. The alloying is done while operating as an electric furnace.

The process constitutes duplexing in a single container and, whereas it would have the advantages of duplexing, including the soda-ash treatment of the cupola iron, there would obviously be some serious refractory problems.

Rotary Fuel-Fired Furnace

The Sesci type of rotary, fuel-fired melting furnace continues to get considerable attention abroad. Faulkner, in THE FOUNDRY TRADE JOURNAL, March 23, 1939, describes a plant at Crewe, in which two 5-ton capacity Sesci furnaces are in operation. These are fired with pulverised anthracite coal and are equipped with recuperators for preheating the air used for combustion. They are acid-lined and the charge must be low enough in sulphur to allow a pick-up of 0.012 per cent. Steel is made to chemical specifications and of acceptable physical quality. The biggest problem apparently concerns the short life of the refractories. Some work is being done on the use of basic refractories, but no data are at present available.

Open-Hearth

An experimental open-hearth furnace of unorthodox design has been built at the plant of E. J. Lavino & Company, for the primary purpose of testing refractories. The melting chamber is rectangular in shape, and it is fired with oil burners placed in the long sides. Those burners are staggered with respect to those in the opposite wall, and are tilted so that the flame impinges on the bath. The unique feature of this furnace is that the air for combustion is not preheated, yet it is claimed that steel baths have been heated to 1,925 deg. C. This is said to be possible because of the special type of burner used, which was designed by Dr. G. E. Seil, of the same company.

Exothermic Processes

A number of exothermic processes for melting steel or alloys have been introduced and are now being tested. One of these is advocated by Maurice Stritmatter, of Paris, for the production of small lots of expensive alloy steels, such as 18-8 stainless. The process apparently makes use of the well-known Thermit reaction to melt stainless-steel scrap, ferro-chromium and nickel shot in the correct proportions, although it is claimed that there are important deviations from the usual Thermit reactions. A member of this committee, having witnessed a test, reports that steels of correct analysis and suitable castability can be produced in this manner, and a foundry not equipped with a sufficiently small melting unit might utilise this process for the production of small, high-alloy castings, urgently needed. In this case cost would not be the determining factor.

Another method utilises a silicothermic reaction to produce molten ferro-chromium for alloying steel or iron. Two products of this nature are produced, one a low-carbon and the other a high-carbon material. They are supplied in package form as powder or briquettes with a definite weight of chromium in each package. They are used for alloying steel by placing a known quantity on a steel bath, container and all, either in the furnace or ladle. The hot steel starts the exothermic reaction which produces ferro-chromium and a fluid slag. The alloying is thus accomplished quickly and without changing the temperature of the bath.

"Chrom-X" is advocated for ladle additions wherever possible, and it is claimed that in this use a consistent recovery of 90 to 95 per cent. of the chromium is obtained. Low-carbon "Chrom-X," added in the furnace, has been used to make 5 per cent. and 12 per cent. Cr steels in an open-hearth furnace. The purported advantages of "Chrom-X" are in lowering costs through shortening the time of a heat, alloying without chilling the bath, and greater flexibility and accuracy in alloying.

Rapid Carbon Determinations

Two new instruments for rapid determinations of preliminary carbons have been introduced in the last couple of years. One of these is the "carbonalyser," described by Work and Clark ("Metals Technology," December, 1939), and the other was described by Blosjo (Trans., A.F.A., 1939). Both of these instruments are attractive because of low cost, ruggedness, simplicity and portability. Reports from the field by those who have been using them indicate a very satisfactory degree of accuracy for them.

Temperature Measurements

Because of the variation in emissivity of metals and slags, which leads to uncertainty in applying correction factors, plus the inherent error due to smoke or fume, optical temperature readings of molten steel leave something to be desired. For this reason considerable interest has been shown in the use of thermocouples for this purpose.

The Fitterer couple of graphite-silicon carbide has been used somewhat in America, but in England a great deal of work has been done with platinum-platinum-rhodium and tungsten-molybdenum couples. This latter work and the apparatus used is described in detail in the Iron and Steel Institute Special Report No. 25, which is included in the Eighth Report on the Heterogeneity of Steel Ingots.

In Sweden, Fornander and Omberg (Jernkontorets Annaler, November, 1939) likewise experimented with, and are favourably impressed by, the tungsten-molybdenum couple.

* Report by the Methods of Producing Steel for Castings Committee of the American Foundrymen's Association.

Catalogues Received

Cranes. Because of the impressive illustrations, the trade literature dealing with overhead travelling cranes is invariably interesting, and this remark well applies to an eight-page brochure just issued by Craven Brothers Crane Division, Limited, of Loughborough. Whilst two of the jobs illustrated are for servicing foundries, the majority are shown installed in steelworks. Some interesting modifications are shown incorporating the use of magnets.

Furnaces. Carrying the caption, "Furnaces for the Railway Industry," the Incandescent Heat Company, Limited, of Cornwall Road, Smethwick, Birmingham, in conjunction with its associated concerns, has issued a particularly interesting twelve-page brochure, which illustrates and describes an extremely wide range of furnaces. Whilst some of the plants illustrated are specially designed for that industry, such as a tyre-heating furnace, the majority are of general application. Typical of this is the oil-fired bogey-fed malleable annealing oven. It is proposed to follow up the issue of this brochure with others covering a variety of industries, including vitreous enamelling.

FRY'S SOLDER & FLUX REFERENCE TABLES

For many years Fry's Metal Foundries have maintained a research staff investigating not only the purely scientific problems connected with the production of better solder and fluxes, but also the practical problems confronting the ordinary and the specialised solder user. We shall be pleased to co-operate in the solution of solder users' difficulties and to give metallurgical advice. Copies of technical publications on solders and fluxes supplied free on request.

HIGH TEMPERATURE SOLDER

for hot water appliances, armatures, and any soldered joint to resist temperatures of over 100° C. (212° F.).

Number	Melting Range	Brinell Hardness at 15° C.	Brinell Hardness at 100° C.	Brinell Hardness at 180° C.
H.T.3	235/240° C.	10.3	5.45	3.0
L.S.1	305/312° C.	7.1	5.35	3.0
L.S.2	305° C.	7.1	4.95	3.0

FUSIBLE SOLDER

Grade	Melting Temperature C	Melting Temperature F	Grade	Melting Temperature C	Melting Temperature F
Fry's No. 2 Alloy	70°	158°	Fry's Tube Bending Alloy	71°	160°
Fry's No. 9 Alloy	93°	203°	Fry's Alloy for Die and Punch Mounting	120°	248°
Fry's No. 15 Alloy	138°	281°			
Fry's No. 17 Alloy	124°	256°			

DIPPING SOLDERS

Grade	Melting Range	Using Temperature	Weight : lb./cu. in.	Weight : lb./cu. ft.
T.R.	183/210° C.	280/300° C.	0.32	552.96
No. 1	183/230° C.	310/330° C.	0.338	584.0
2	183/255° C.	330/350° C.	0.325	608.256
3	183/290° C.	340/400° C.	0.372	642.816

TINMAN'S SOLDERS

Grade B.S.S.	Melting Temperature	Tensile Strength : tons/sq. in.	Elongation %	Brinell Hardness
A	185° C.	4.9	20	13.9
B	205° C.	4.4	67	12
C	230° C.	4.1	63	11.3
D	255° C.	3.8	53	8.7
F	210° C.	3.8	69	12
K	185° C.	4.0	52	13.9

DIPPING FLUXES

ACTIVE	"FRYSOL" Soldering Fluid "FRYSOL" 3	An active flux suitable for dipping of steel, copper, brass and all general work. Approved for A.I.D., I.N.O. and W.O. work. Recently developed active flux similar to "FRYSOL" but having especial advantages for small dipping work. It has a high wetting power and eliminates spattering when the work is immersed in the molten solder.
SAFETY OR PROTECTIVE	FRY'S OLEIC ACID No. 9 "FRYOLENE" Liquid Flux No. 1	Safety flux approved by: Admiralty, K/767; War Office, CWD/712/A; Air Ministry, AIR/58/1. Suitable for copper, brass and other non-ferrous alloys; may also be used for iron and steel if these are thoroughly cleaned. The flux residue is non-conductive. Safety flux suitable for certain types of iron and steel, nickel and chromium alloys, in addition to non-ferrous alloys. Does not cause spattering. The residue, which is non-corrosive, can be removed with warm water. *N.B.*—"Frysol" 3 and "Fryolene" Liquid Flux are both inflammable and should not be used in large quantities adjacent to naked lights.
COVERING FLUXES	"FRYSOL" Salt	This readily melts when sprinkled on the surface of molten metal, thus preventing excessive oxidation and consequent loss in tin content.
CLEANING & REFINING FLUXES	FRY'S R.2. Flux FRY'S FLUX TABLETS	Contains in finely powdered form an active flux which coagulates the surface oxide and releases the entrapped metal. Have the same effect because they burn on the surface of the bath producing intense local heating. They are especially suitable where a safety flux is used for dipping. After the use of either of these fluxes, the dross, now very much reduced in quantity and consisting of finely powdered oxide, is skimmed off.

SOLDERING FLUXES

TYPE A: "PROTECTIVE FLUXES"	TYPE B: "ACTIVE FLUXES"
"Alcho-re" (Soldering Fluid) / (Soldering Paste) — A.I.D. / W.O. CWD/275C / I.N.O. K./767 — Non-Corrosive Safety Fluxes	"Frysol"— Tinning Salt, Soldering Fluid, Soldering Paste Flux — Fluxes for all General Soldering, Dipping, etc.
Oleic Acid No. 9	"Fryolux" Solder Cream / "Fryolux" Solder Paste — A mixture of high grade solder and flux combined.
"Fryolene" Paste Flux—Rapid action, Non-corrosive Flux for Ferrous and Non-ferrous Metals	
Zinc Flux . . . Non-corrosive Flux for Zinc and Zinc Alloys, and Galvanised Iron	

FRY'S METAL FOUNDRIES LTD

TANDEM WORKS · MERTON ABBEY · LONDON · S·W·19

Telephone:- MITCHAM 4023

The Week's News in Brief

Trade Talk

THE SALEM ENGINEERING COMPANY, LIMITED, have moved their offices from London to Milford House, Milford, near Derby.

THE INTERNATIONAL TIN RESEARCH AND DEVELOPMENT COUNCIL is in future to be known as the Tin Research Institute.

A RAILING EXHIBITION in Edinburgh in the near future is proposed as a means of increasing the flow of scrap metal from that source.

THE ADDRESS of the British Iron and Steel Federation and the British Iron and Steel Corporation, Limited, is now Ashorne Hill, Ashorne, near Leamington.

DAVIDSON & COMPANY, LIMITED, Sirocco Engineering Works, Belfast, have opened a new depot at Briggate House, Albion Place, Leeds, 1, with the object of giving better service to local clients.

THE BRITISH SHEET METAL ASSOCIATION has been registered as a private company with a nominal capital of £100. The solicitors are Brown, Turner, Compton, Carr & Company, 11, St. George's Place, Southport.

AN EXTRAORDINARY GENERAL MEETING of Nasmyth, Wilson & Company, Limited, engineers, is to be held on November 7, for the purpose of considering a resolution for the voluntary winding-up of the company.

REPRESENTATIONS having been made to the Government by the Amalgamated Engineering Union regarding compensation to their members for the loss of tools through air raids, it has been agreed that compensation for the loss of tools exceeding £1 in value shall be paid up to a maximum amount of £50 to men whose incomes are between £250 and £400.

SPEAKING IN THE House of Commons recently, Mr. Stokes asked the Minister of Supply whether he proposed to continue the annual payment of £221,400 to the British Metal Corporation, Limited, for managing the non-ferrous metal control. Sir Andrew Duncan replied he did not propose to interfere with the terms of the agreement. Mr. Stokes was under a misapprehension in stating that these terms amounted to guaranteeing the Corporation's pre-war level of profits. The annual fee was made up in the main of an allowance for the cost of staff and expenses incurred on account of the Control and for the services of the company in putting their organisation and certain of their revenues at the disposal of the Ministry.

FREDK. CRANE CHEMICAL COMPANY, LIMITED, has gone into voluntary liquidation, and in future will trade under the name of I.C.I. (Paints), Limited. It will be remembered that in April last it was announced that Nobel Chemical Finishes, Limited, would henceforward be known as I.C.I. (Paints), Limited. The Fredk. Crane Chemical Company was established in Birmingham in 1887 as a manufacturer of nitro-cellulose lacquers. With its products cold lacquering became possible in place of the hot-lacquering process previously applied to metal articles in order to prevent them tarnishing. In 1912 the company moved to larger premises at Bordesley Green, and in 1937 opened a modern paint factory at Smethwick. As the Fredk. Crane Chemical Company was a subsidiary company of I.C.I. (Paints), Limited, the two companies are now merged completely, without change of personnel or policy.

The Sir Henry Fildes Medal

The Council of the Institution of Factory Managers has decided to establish an annual silver medal in honour of the first President, Sir Henry Fildes, Kt., M.P. The medal will be awarded this year for the best essay on some aspect of improved methods of factory management, and any factory manager in the British Empire will be eligible to compete. A length of 5,000 words is suggested. The essays should be typewritten, and a broad margin should be left. Competitors need not be members of the Institution. Essays should be sent as soon as possible, and in any case not later than November 30, to the Secretary of the Institution, Mr. L. M. Angus-Butterworth, M.I.Mech.E., Ashton New Hall, Ashton-on-Mersey, Cheshire.

Personal

SIR CLIVE BAILLIEU has been elected chairman of the Imperial Smelting Corporation, Limited, and Mr. L. B. Robinson has been appointed to a seat on the board.

LIEUT.-COL. JOHN BEAUMONT NEILSON has been elected a director of Lloyds Bank, Limited. He is vice-chairman of Baldwins, Limited, deputy-chairman of Vickers, Limited, and chairman or a director of a number of other companies.

DR. AUREL STODOLA, of Zürich, has been awarded the James Watt International Medal by the Council of the Institution of Mechanical Engineers, on the recommendation of the Engineering Institute of Canada, the Czecho-Slovak Society of Engineers, and the Swiss Society of Engineers and Architects.

MR. WALTER TWEEDALE has resigned his position as managing director of Tweedales & Smalley (1920), Limited, textile machinery makers, Rochdale, but will continue as chairman. Mr. Edward Smalley, Mr. Norman Tweedale and Mr. John Hughes have been appointed joint managing directors.

DR. ROBERT ROBERTSON has been re-elected chairman of the Governors of the Royal Technical College, Glasgow, for the tenth year in succession. As a wartime measure it has been decided to appoint a Vice-President. Dr. J. W. French, of Barr & Stroud, Limited, has been elected to that office.

MR. W. A. WOODESON, chairman of Clarke, Chapman & Company, Limited, engineers, Gateshead, has been elected President of the North-East Coast Institution of Engineers and Shipbuilders. Mr. Woodeson has had 50 years' association with Clarke, Chapman & Company. He was appointed a director in 1910 and chairman 12 years ago. He is also chairman of several other engineering concerns.

MR. BENJAMIN TALBOT has been elected chairman of the South Durham Steel & Iron Company, Limited, and the Cargo Fleet Iron Company, Limited, in succession to the late Viscount Furness. Mr. Talbot retains his position as managing director. Mr. Chas. J. Bagley, who was one of the original directors, and managing director of the South Durham Steel & Iron Company, Limited, has, owing to age, resigned his position as director. Mr. Arthur Sladden, who has been secretary of the South Durham Company since its inception and a director since 1925, has also resigned his appointments.

Obituary

MR. AUSTIN MILLS, an employee for nearly 50 years at the Torwood Foundry of Jones & Campbell, Limited, Larbert, has died, aged 74.

MR. MURRAY BARCLAY BUXTON, M.C., chairman of H. Young & Company, Limited, and President of the Institution of Structural Engineers, has died.

MR. JOSEPH FISHER has died as the result of enemy action. He was formerly with Colvilles, Limited, and the British Iron and Steel Corporation.

MR. DONALD H. THOMSON, a director of James Bertram & Son, Limited, paper-mill engineers, of Edinburgh, has died in a nursing home. Aged 54, he had been a member of the firm for 17 years, and a director for 12 years.

DR. C. H. MERZ, senior partner in the firm of Merz & McLellan, consulting engineers, died recently. Born at Gateshead-on-Tyne in 1874, he designed and carried out electric power and traction schemes in various parts of the world.

COL. EDMUND WALKER RENNY PINKNEY, a director of Swan, Hunter & Wigham Richardson, Limited, and chairman of the works board of the Shipbuilding Employers' Federation, died at Newcastle-upon-Tyne last week, aged 64 years. In the last war he received the D.S.O. in 1917 and was mentioned in dispatches.

THE DEATH is announced of Mr. G. H. Nisbett, vice-chairman of British Insulated Cables, Limited, at the age of 73. Throughout his long career, Mr. Nisbett was an enthusiast for research and took a leading part in the formation of the Cable Research Association. This, coupled with his work in connection with technical education, was recognised by the University of Liverpool, which conferred upon him the honorary degree of Master of Engineering.

WE REGRET to record the death of Mr. E. L. Rhead, M.Sc.Tech., F.I.C., who for many years was Head of the Department of Metallurgy at the Manchester College of Technology, and Lecturer in Metallurgy in the University of Manchester, from which position he retired about nine years ago. He was 75 years old. Mr. Rhead was one of the first metallurgists in this country to endeavour to establish ironfoundry practice on a scientific basis, and his classes in this subject were the means by which a whole generation of Lancashire foundrymen received their technical training. His textbook on modern ironfounding was for years a standard work of reference. He was also well known in the wider field of general metallurgy, and several of his former students achieved considerable distinction. He was the author of a textbook on metallurgy which was widely used in technical colleges, and was joint author with the late Prof. Hambolt Sexton of a work on metallurgical analysis and assaying. He presented numerous Papers to scientific societies, including the Institute of British Foundrymen, of which he was an honorary member. Old students of Mr. Rhead in many parts of the world will remember him with gratitude and affection. He communicated to them his own enthusiasm for his subject and the results of his wide experience were always at their disposal long after their student days were over. His interest and guidance extended beyond their technical associations to their personal interests, and many of them came to regard him as a close and sympathetic friend.

Reports and Dividends

Lightalloys, Limited—Final dividend of 12½ per cent., making 25 per cent. for the year.

Dickson & Mann, Limited—Profit for year to March 31 last of £1,828, reducing the debit carried forward to £3,443.

Nasmyth, Wilson & Company, Limited—Loss for the year ended December 31, 1939, of £2,663. Meeting, November 7.

Imperial Smelting Corporation, Limited—Dividend of 3½ per cent. on the ordinary shares for the year ended June 30.

Renold & Coventry Chain Company, Limited—Net profit for the year to June 30 last, after providing £94,000 for taxation, £99,330; brought in, £15,541; ordinary dividend of 10 per cent.; to contingencies reserve, £30,000; carried forward, £21,407.

Forthcoming Events

NOVEMBER 7.

Institute of Metals (Birmingham Section):—"Gas-Producer Plant and Practice," Paper by L. Bailly, at James Watt Memorial Institute, at 6.30 p.m.

NOVEMBER 8.

Institute of Metals (Sheffield Section):—"Deep Drawing of Metals," by Prof. H. W. Swift, at Department of Applied Science, Sheffield, at 7.30 p.m.

NOVEMBER 9.

Manchester Association of Engineers:—"Temperature Determination on Moving Machine Parts," Paper by Prof. H. Wright Baker, at Engineers' Club, Manchester, at 2.30 p.m.

Institute of British Foundrymen

NOVEMBER 2.

Lancashire Branch:—"Some Points in Casting Production," Paper by E. Longden, at Engineers' Club, Manchester, at 3 p.m.

NOVEMBER 9.

Scottish Branch:—"Application of Lifting Magnets and Magnetic Separators in Foundries, etc.," Paper by W. E. Box, at Royal Technical College, Glasgow, at 3 p.m.

West Riding of Yorkshire Branch:—Discussion of American Exchange Paper, "Developments in Gating and Risering for High-Test Cast Iron," by A. E. Cartwright and C. C. Brisbois, introduced by V. Delport, at Technical College, Bradford, at 6.30 p.m.

NOVEMBER 12.

Burnley Section:—"One Way of Making a Loam Mould," Paper by J. Potter, at Municipal College, Burnley, at 7.30 p.m.

A Refractories Industry within one organisation

The spectacular achievements of industries which use refractories tend to overshadow the remarkable development of refractory materials during recent years. Higher temperatures and increasingly severe operating conditions have long since deposed "rule-of-thumb" methods of manufacture. Research—applied by the refractories industry, by manufacturers (such as General Refractories), and by users—has developed a range of refractories which are, at least, abreast of to-day's metallurgical processes and plant design. Unrivalled supplies of raw materials—the employment in its many works of modern plant and equipment—the services of leading technicians, operating in works bearing names familiar to all users—and supported by a wealth of practical experience—enable General Refractories to operate a complete refractories industry inside one organisation. And, influencing all activities, controlling production and future development, is "G.R." Research. In modernly equipped laboratories a team of qualified chemists and engineers build into each "G.R." product that consistently uniform quality which is the basis of low operating costs and long dependable service.

GENERAL REFRACTORIES LTD.

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G.P.I.

FIREBRICKS: *Glenboig Special, Glenboig Special Crown, Glenboig, Glenboig Crown, Castlecary, Dykehead, Gem, White Carr, Stour, Hycone, Alumantine, Hysilyn, Adamantine, Llangennech.*
BASIC BRICKS: *Spinella, Saxpyre, Supermag, Diazite, Dolomax.*
ACID-PROOF REFRACTORIES: *Obsidianite, Losol.*

INSULATION: *Amberlite* Bricks, Cement and Concrete.
SILICA BRICKS: *Lowood, Meltham, Allen, Quartex.*
CEMENTS: *Sintex, Durax, Pyrolyte.* PLASTICS: *Durax, Rotaline, Plastic K-N., Glendoline, Ground Ganister.*
SILLIMANITE: Tank Blocks, Bricks and Cements.
SANDS: Moulding, Brick Facing, Silica, Glass.

Raw Material Markets

An announcement regarding future iron and steel prices is expected to be made to-day (Thursday). Any changes in present levels will, of course, be in an upward direction, but it is certain that higher prices will not result in any falling away in demand. Ironmakers are able to cope fairly well with consumers' requirements, but there is little to spare of most descriptions after priority demands have been dealt with, while almost the full output of steel is accounted for by Government specifications. Substantial tonnages of both iron and steel are still being imported from the United States, and it is largely to provide funds to pay for these supplies that a rise in selling prices is being made. Increased freight charges on the railways have also to be met.

Pig-Iron

MIDDLESBROUGH—With foundries in the Cleveland area mostly fully employed on Government work, consumption of foundry numbers is heavy. The production of Cleveland iron is negligible, but large tonnages of Midlands iron are arriving regularly. In addition, supplies of scrap are quite considerable, thus relieving the pressure on pig-iron. There has been no official notification of any change in prices, but it is believed that new rates will be introduced as from November 1. The situation with regard to East Coast hematite is slightly easier, although the full output continues to move into consumption as available, users having exhausted their stocks. The tight position at home has been rectified to some extent by heavy importations and supplies of foreign iron have been allocated where the need is most urgent. Imports are now coming to hand much more freely, but it is hoped that home production will be expanded, as the cost of importing hematite from abroad is high.

LANCASHIRE—Supplies of Derbyshire and other brands of Midland common irons are being delivered to Lancashire consuming works in satisfactory tonnages, and there is little delay in meeting all priority orders. The chief demand emanates from firms dealing with Government contracts, but a moderate inquiry is forthcoming from jobbing foundries, although there has been a slight falling off in new business among this branch of late. Light-castings makers are unable to report better conditions on the whole, but certain foundries have been fortunate in receiving munitions orders, and these works are naturally busier than others relying on ordinary domestic trade. Supplies of West Coast hematite remain rather restricted.

MIDLANDS—Delay in announcing new pig-iron prices has been longer than was expected, but it is believed that higher quotations will operate as from to-morrow (Friday). The decision to increase railway freight charges makes the need for higher selling prices all the more necessary. The light-castings trade is open to receive much more new business, and in the present circumstances many foundries are unable to employ their plant on a full-time basis. Comparatively few have secured any large amount of Government specifications, and until more official work is available, the trade cannot hope to become active. High-phosphorus iron is used largely in the manufacture of light castings and an ample supply is being delivered. Most heavy engineering concerns have sufficient work on hand or in sight to maintain full-scale operations over a long period ahead. Low-phosphorus iron, hematite and refined irons are the main requirements of these works, and it is satisfactory to report that better tonnages are now being delivered following larger imports. Licences have been granted generally to cover consumers' needs up to the end of the year, but in some instances users have bought as far ahead as January of next year.

SCOTLAND—Pig-iron consumers are obtaining sufficient iron for current needs, but no provision can yet be made for stocking. Local users are taking all the Midlands iron they can get, but licences have to be secured to cover all fresh business and these are only issued when the iron is required for early consumption. Heavy founders are still very active, but there has been further improvement among the light-castings foundries and it is expected that further progress will be made in this branch.

Coke

Although many ironfounders have accumulated large stocks of coke, they are buying their current requirements, so that reserves may be left intact. Consequently business is quite brisk. For delivery to Birmingham and Black Country stations, the current price of Durham best foundry coke is 55s. 6d. per ton, this figure being subject to a rise-and-fall clause.

Steel

With the aid of large-scale imports from abroad, priority users of steel are receiving adequate tonnages, but much more could be absorbed by ordinary uses if it were available. Home steelworks are working to capacity on Government orders, and little material can be spared for other purposes. It has been announced by Mr. Herbert Morrison, Minister of Supply, that 12,000 tons of steel have been released for the construction of sleeping berths for air-raid shelters, about 600,000 berths being erected as a result of this allocation of steel. The flow of raw materials to the steelworks has improved still further, and, apart from occasional stoppages for repairs, furnaces are in continuous production.

Scrap

The Steel Control, co-operating with local authorities, is understood to have set up the organisation necessary for carrying out a comprehensive survey of the nation's potential supplies of heavy scrap which was promised by the Minister of Supply some months ago. This survey should provide useful information as to prospects of scrap supplies, even though the present position is quite satisfactory. Merchants are having difficulty in ridding themselves of certain descriptions of scrap and foundry grades, particularly, are in good supply. Many foundries have, in fact, been enabled to revert to their former practice of using more scrap relative to pig-iron in their mixtures.

Metals

Manufactured copper products are in increasing demand by Government departments, and imports of semi-finished products are still necessary from time to time. Home makers are producing satisfactory tonnages, however, and there are adequate quantities of raw copper to enable makers to work to full capacity. So great has been the activity in the United States copper market this month that it is believed in some quarters that there is a strong possibility of copper being imported to assist national defence requirements from South American mines owned by U.S. interests. The demand for the metal during the past month or two has been at record levels. It is pointed out in trade circles that the 4 per cent. import tax would not be effective on copper imported by a Government agency, which could hold the metal as an emergency reserve and release it to the consumers as the demand arose.

The decision of the American Government to erect a tin smelter in the United States is regarded in London as inevitable in present circumstances, and the project is, in fact, being aided by the advice of Mr. Ernest V. Pearce, managing director of Williams, Harvey & Company, operators of the largest tin smelter in England, which takes the greater part of the Bolivian tin production. Mr. Pearce is now in the United States at the invitation of the Patino Mines concern. Thus the scheme has the blessing of British smelters, most of whom do not expect Bolivian tin to be smelted in America after the war. Mr. E. R. Stettinius, jun., of the U.S. National Defence Commission, stated recently that stocks of tin were sufficient to meet estimated consumption for about one year. Stocks include Government purchases and industrial stocks both in the United States and afloat. A recent issue of the New York "Herald-Tribune" contained a report to the effect that the U.S. Government was buying up every pound of tin available in the Dutch East Indies for quick shipment.

London Metal Exchange tin prices this week have been as follow:—

Cash—Thursday, £258 to £258 5s.; Friday, £258 15s. to £259 5s.; Monday, £259 10s. to £259 15s.; Tuesday, £259 15s. to £260; Wednesday, £259 5s. to £259 10s.

Three Months—Thursday, £260 5s. to £260 10s.; Friday, £261 to £261 10s.; Monday, £261 5s. to £261 15s.; Tuesday, £261 15s. to £262.; Wednesday, £261 10s. to £262.

Heavy quantities of spelter are being absorbed by the war machine, but supplies for this purpose are plentiful, if other consumers are not receiving all the metal they would like. The market in America is still rather tight. A recent survey by the American Zinc Institute reveals that zinc smelting facilities in the U.S.A. are ample for current requirements, but the statistical position appears to show that effective smelting capacity at the moment is below the level of demand.

Industrial demand for lead in the United Kingdom is maintained at a high level, especially by concerns dealing with Government orders, as many of the peacetime outlets have been lost to lead users. The American market is quite brisk, with the current quotation 25 points higher at 5.50 cents per lb., New York.

Applications for Trade Marks

The following list of applications to register trade marks has been taken from the "Trade Marks Journal":—

"HYPERSILID"—Ferrous castings (in the rough) and ingots. BRADLEY & FOSTER, LIMITED, Darlaston, Staffs.

"AUDAX," "AURIGA," "IMPAX," "PHALANX"—Metals and alloys. David Brown & Sons (Huddersfield), Limited, Park Gear Works, Lockwood, Huddersfield.

New Company

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

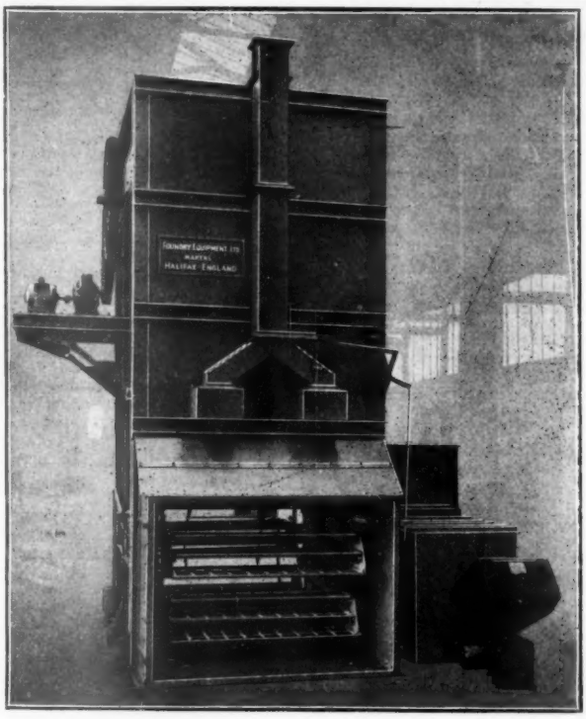
Bernard Sunley & Sons, Limited—Capital, £10,000. General engineers, etc. Director: B. Sunley. Subscriber: N. M. Grundy, 9, Barnfield Road, Belvedere, Kent.

Alloy Iron Tannery Equipment

Alloy cast iron has recently been adopted in America for the rolls of staking machines which are used in tanneries for softening and stretching leather after tanning. In these machines the leather is pounded by passing through a set of finned rollers. These rollers are centrifugally cast in a close-grained, machinable cast iron containing upwards of 1 per cent. of nickel, the spiral fins or vanes being generally of Monel or copper. Latterly, a number of rolls have been made from the higher alloy iron "Ni-Resist" with Monel vanes. The rolls weigh about 600 lbs. Small components of the machines for which nickel cast iron is employed include sheaves, brackets, sprockets, side-frames and bearing caps, for all of which wear resistance is needed.

C.I. Melting Pot Materials

Many aircraft components are produced by stamping out with a drop hammer using dies made of a special zinc-aluminium-copper-magnesium alloy. Steel or iron pots used for melting this alloy are attacked by the molten metal and have a very short life. An American producer, after trying out various compositions, has standardised on an alloy iron of the following composition:—C, 3.40; Si, 1.60; Mn, 0.60; Ni, 2.20, and Cr. 1.10 per cent. The pot castings are normalised before use, which treatment forms a hard surface scale that seems to inhibit further corrosion and prevents contamination of the die material with iron or iron oxide. All rough surfaces on the inside of the pots are ground off smooth to prevent starting places for corrosive action. Melting pots of this alloy have given up to five months continuous service, which is much longer than the service usually obtained.



CONTINUOUS CORE STOVES

TREMENDOUS PRODUCTION

Illustration shows stove, with Automatic Stoker.
Also made for ordinary hand coke firing.

Let us send you details!

FURNACES
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Latest design Mixers delivered from stock

Send your enquiries for any FOUNDRY MECHANISATION to the makers:—

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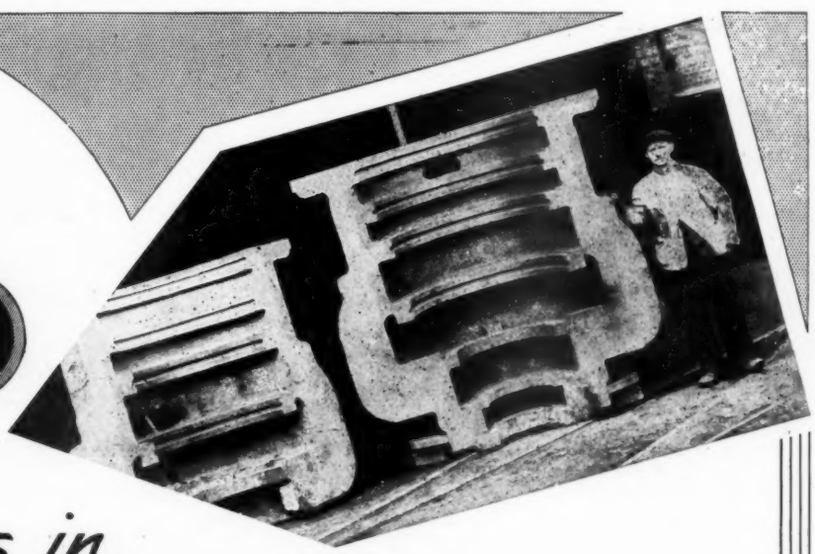

ON ADMIRALTY, WAR OFFICE, AIR MINISTRY, LLOYDS, AND OTHER APPROVED LISTS.

JAMES BRIDGE STEEL WORKS near WEDNESBURY..

'PHONE DARLASTON 225 (3 lines)
'GRAMS STEEL DARLASTON

STEEL CASTINGS

From a few ounces up to **25 TONS**

FOR ALL INDUSTRIES

RAW MATERIALS—PRICE LIST

Wednesday, October 30, 1940

COPPER*

	£	s.	d.
Electrolytic	62	0	0
High-grade fire-refined	61	10	0
Fire-refined of not less than 99.7 per cent.	61	0	0
Do., do., 99.2 per cent.	60	10	0
Black hot-rolled wire rods	65	10	0

TIN

	£	s.	d.
Standard cash	259	5	0
Three months	261	10	0
Settlement	259	5	0
Official average Cash, Sept.	251	6	10½
Do. Three Months, Sept.	254	4	7½
Do. Settlement, Sept.	251	7	4½

SPELTER*

	£	s.	d.
G.O.B. (foreign) (duty paid)	25	15	0
Do. (domestic)	26	10	0
"Prime Western"	26	10	0
Refined and electrolytic	27	5	0
Not less than 99 99 per cent.	28	15	0

LEAD*

	£	s.	d.
Good soft pig lead (foreign) (duty paid)	25	0	0
Do., do., (Empire and domestic)	25	0	0
English	26	10	0
Sheets, home	34	10	0
Do. export, f.o.b.	30	0	0
Pipes, home	34	0	0
Do. export, f.o.b.	30	10	0
Tea lead (nom.)	—		

ALUMINIUM

Ingots	£110
Wire, 10g.	nom.
Sheets	nom.
Circles, 20/24g.	nom.

ZINC SHEETS, etc.

	£	s.	d.
Sheets, 10g. and thicker, ex works	39	2	6
Rolled zinc (boiler plates), ex works	37	2	6
Zinc oxide (Red Seal), d/d buyers' premises	28	7	6

ANTIMONY

	£	s.	d.
English, 90%, delivered	90	0	0
Foreign Regulus, duty paid	90 0 0 to 93	0	0
Chinese, prompt shipment, c.i.f.	78 0 0 to 82	0	0

QUICKSILVER

Quicksilver, ex-w'hse London 50 0 0 to 54 10 0

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	3s. 0d.
Finished bars, 18% tungsten	3s. 10d.
Finished bars, 22% tungsten	4s. 4d.

Per lb. d/d buyers' works.

NICKEL SILVER, etc.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
to 10g.	1/6½ to 2/1½

with extras according to gauge.

Special 5ths quality turning rods in straight lengths, 1/5½ upwards.

* Maximum prices per long ton delivered to buyers' premises.

FERRO-ALLOYS AND STEEL-MAKING METALS

(all prices nominal.)

	£	s.	d.
Ferro-silicon (5-ton lots)—			
25%	18	10	0
45%	23	10	0
75%	36	10	0
Ferro-vanadium—			
35/50%	15/6 lb. Va.		
Ferro-molybdenum—			
70/75% carbon-free	6/- lb. Mo.		
Ferro-titanium—			
20/25% carbon-free	1/9 lb.		
Ferro-tungsten—			
80/85%	5/1 lb		
Tungsten metal powder—			
98/99%	5 2½ lb.		
Ferro-chrome—			
2/4% car.	—		
4/6% car.	47	0	0
6/8% car.	47	0	0
8/10% car.	—		
Ferro-chrome—			
Max. 2% car.	—		
Max. 1% car.	—		
Max. 0.5% car.	—		
70% carbon-free	—		
Nickel—99.5/100%	£190 to £195		
"F" nickel shot	175	0	0
Ferro-cobalt, 98/99%	8/9 lb.		
Metallic chromium—			
96/98%	3/9 lb.		
Ferro-manganese—			
76/80% loose	18	0	0
76/80% packed	19	10	0
Metallic manganese—			
94/96% carbon-free	1/9 lb.		

Per ton unless otherwise stated, basis 2-ton lots, d/d Sheffield works.

SCRAP*

	£	s.	d.	£	s.	d.
SOUTH WALES—						
Short heavy steel, not ex. 24-in. lengths	3	16	6 to	3	19	0
Heavy machinery cast iron				4	6	6
Ordinary heavy cast iron				4	1	6
Cast-iron railway chairs				4	6	6
Medium cast iron				3	17	9
Light cast iron				3	13	0
MIDDLESBROUGH—						
Short heavy steel	3	14	3 to	3	16	9
Heavy machinery cast iron				4	11	3
Ordinary heavy cast iron				4	8	9
Cast-iron railway chairs				4	8	9
Medium cast iron				3	19	0
Light cast iron				3	14	0
BIRMINGHAM DISTRICT—						
Short heavy steel	3	9	3 to	3	11	9
Hematite ingot mould				5	10	9
Heavy machinery cast iron				4	11	9
Ordinary heavy cast iron				4	7	0
Cast-iron railway chairs				4	7	0
Medium cast iron				3	19	9
Light cast iron				3	14	9
SCOTLAND—						
Short heavy steel	3	14	0 to	3	16	6
Heavy machinery cast iron				4	13	9
Ordinary heavy cast iron				4	8	9
Cast-iron railway chairs				4	13	9
Medium cast iron				3	16	9
Light cast iron				3	11	9

* Delivered free to consumers' works in England and Wales. For deliveries of cast-iron scrap free to consumers' works in Scotland, the above prices less 3s. per ton, but plus actual cost of transport or 6s. per ton, whichever is the less. All prices: Plus 2½ per cent. dealers' remuneration: 50 tons and upwards over three months 2s. 6d. extra.

PIG-IRON*

N.E. COAST (d/d Tees-side area)—	
Foundry No. 1	123/-
„ No. 3	120/-
„ No. 4	119/-
Forge No. 4	119/-
Hematite No. 1	131/-
Hematite M/Nos.	130/6
N.W. COAST—	
Hem. M/Nos. d/d Glasgow	131/-
„ d/d Birmingham	142/6
MIDLANDS (d/d Birmingham dist.)—	
Staffs No. 4 forge	121/-
„ No. 3 fdry.	122/-
Northants forge	118/6
„ fdry. No. 3	119/6
„ fdry. No. 1	122/6
Derbyshire forge	121/-
„ fdry. No. 3	122/-
„ fdry. No. 1	125/-
Phosphorus 0.5% to 0.75%	129/6
Phosphorus 0.1% to 0.5%	132/6
SCOTLAND—	
Foundry No. 1, Grangemouth	119/9
„ No. 3, Grangemouth	117/3
Cleveland No. 3, Glasgow	123/-
„ „ Falkirk	120/-
Scottish hem. M/Nos. d/d	131/-
SHEFFIELD (d/d district)—	
Derby forge	118/6
„ fdry. No. 3	119/6
Lincs forge	118/6
„ fdry. No. 3	119/6
W.C. hematite	136/6
LANCASHIRE (d/d eq. Man.)—	
Derby fdry. No. 3	125/-
Staffs fdry. No. 3	125/-
Northants fdry. No. 3	123/6
Cleveland fdry. No. 3	125/-
Cylinder and Refined Irons	
North Zone	168/-
South Zone	170/6
Refined Malleable	
Birmingham and S. Staffs	165/6
Cold Blast	
South Staffs	217/-

* Prices of hematite and basic pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton under certain conditions.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms and Slabs.

	£	s.	d.
BASIC:			
Soft, u.t., 100-ton lots	10	10	0
Tested, up to 0.25% C.	10	15	0
Tested, 0.25 to 0.33% C.	10	17	6
Tested, 0.33 to 0.41% C.	11	0	0
Hard (0.42 to 0.60% C.)	11	17	6
„ (0.61 to 0.85% C.)	12	7	6
„ (0.86 to 0.99% C.)	12	17	6
„ (1% C. and up)	13	7	6
Silico-manganese	14	5	0
Free-cutting	12	10	0
SIEMENS MARTIN ACID			
Up to 0.25% C.	13	15	0
Case-hardening	14	12	6
Silico-manganese	14	10	0

Billets, Blooms and Slabs for Forging and Stamping.

Basic soft, up to 0.25% C.	12	2	6
Basic hard, 0.41 to 0.60% C.	12	10	0
Acid, up to 0.25% C.	14	5	0

Other Semi-products, etc.

Tin bars	10	7	6
Sheet bars	10	7	6
*Wire rods, soft basic	15	4	0
„ hard basic	18	12	6
„ free-cutting	17	12	6
„ acid	22	3	6

* Subject to rebate

FINISHED STEEL

Usual district deliveries.

[A rebate of 15/- per ton for steel bars, sections plates, joists and hoops is obtainable in the home trade under certain conditions.]

	£	s.	d.
Plates, ship (N.E. Coast)	14	3	0
Boiler plts. (N.E. Coast)	15	0	6
Chequer plts. (N.E. Coast)	15	13	0
Angles, over 4 un. ins.	13	13	0
Tees, over 4 un. ins.	14	13	0
Joists, 3 in. × 3 in. and up	13	13	0
Rounds and squares, 3 in. to 5½ in.	14	13	0
Rounds under 3 in. to ⅜ in. (untested)	15	8	6
Flats—over 5 in. wide	13	18	0
„ 5 in. wide and under	15	8	6
Rails, heavy, f.o.t.	12	15	6
Hoops	16	3	6
Black sheets, 24 g. (4 t. lots)	19	7	6
Galv. cor. shts. („)	22	12	6
Galv. flat shts. („)	23	2	6
Galv. fencing wire, 8g. plain	24	7	6

FINISHED IRON

	£	s.	d.
CROWN IRON:			
England and Wales	15	2	6
Scotland	15	2	6
Ireland, f.o.q.	15	15	0
No. 3 BARS:			
England and Wales	12	5	0
Scotland	13	7	6
Ireland, f.o.q.	12	17	6
No. 4 BARS:			
England and Wales	12	15	0
Scotland	13	12	6
Ireland, f.o.q.	13	7	6
STRIP:			
England and Wales	16	10	0
STAFFS MARKED BARS, f.o.t.	18	0	0

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated, September 24, 1940.

	Dols.
No. 2 foundry, Phila.	24.84
No. 2 foundry, Valley	23.00
No. 2 foundry, Birm.	19.38
Basic, Valley	22.50
Malleable, Valley	23.00
Grey forge, Valley	22.50
Ferro-mang., seaboard	120.00
O.-h. rails, h'y, at mill	40.00
Billets	34.00
Sheet bars	34.00
	Cents
Iron bars, Chicago	2.25
Steel bars	2.15
Tank plates	2.10
Beams, etc.	2.10
Wire rods	2.00
Skelp, grooved steel	1.90
Steel strip	2.10
Steel sheets	2.10
Sheets, galv., 24 g.	3.50
Wire nails	2.55
Plain wire	2.60
Tinplates, 100-lb. box	$5.00

COKE (at ovens)

Welsh foundry	42/6 to 44/-
„ furnace	31/6 to 33/-
Durham foundry	39/6
„ furnace	33/5
Scottish foundry	42/6 to 47/6
„ furnace	31/- to 33/-

TINPLATES

f.o.b Brisfol Channel ports

I.C. cokes 20 × 14 per box	27/6 to 29/-
„ 28 × 20 „	55/- to 58/-
„ 20 × 10 „	36/6 to 39/-
„ 18¾ × 14 „	27/- to 29/3
C.W. 20 × 14 „	25/- to 26/-
„ 28 × 20 „	50/- to 52/-
„ 20 × 10 „	35/- to 36/-
„ 18¾ × 14 „	26/- to 28/-

NON-FERROUS SCRAP

(Official Maximum Prices, per ton ex Works.)

	£	s.	d.
Bright untinned copper wire, in crucible form or in hanks	57	10	0
No. 1 copper wire	57	0	0
No. 2 copper wire	55	10	0
Copper firebox plates, cut up	57	10	0
Clear untinned copper, cut up	56	10	0
Braziery copper	53	10	0
G.F. process and shell-case brass, 70/30 quality, free from primers	49	0	0
Clean fired 303 S.A. cartridge cases	47	0	0
70/30 turnings, clean and baled	43	0	0
Brass swarf, clean, free from iron and commercially dry	34	10	0
New brass rod ends, 60/40 quality	38	10	0
Hot stampings and fuse metal, 60/40 quality	38	10	0
Admiralty gunmetal, 88-10-2, containing not more than ¼ per cent. lead or 3 per cent. zinc, or less than 9½ per cent. tin	72	0	0

NEW BRASS TUBES, etc.

	Per lb.
Solid drawn tubes	13½d.
Brazed tubes	15½d.
Rods, drawn	11½d.
Rods, extd. or rlld.	8½d.
Sheets to 10 w.g.	10½d.
Wire	10½d.
Rolled metal	9½d.
Yellow metal rods	8½d.

COPPER TUBES, etc.

Solid drawn tubes	14½d.
Brazed tubes	14½d.
Wire	9½d.

PHOSPHOR BRONZE

	Per lb. basis
Strip	13½d.
Sheet to 10 w.g.	13½d.
Wire	15½d.
Rods	15½d.
Tubes	20½d.
Castings	17d.

Delivery 3 cwt. free.

10% phos. cop. £35 above B.S.

15% phos. cop. £40 above B.S.

Phosphor tin (5%) £40 above price of English ingots.

C. Clifford & Son, Limited.

AVERAGE MONTHLY PRICES OF STEEL BOILER PLATES IN ENGLAND

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1903	7 10 0	7 10 0	7 15 0	7 5 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	6 17 6	7 3 11½
1904	6 12 6	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 11½
1905	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 10 0	7 5 0	8 0 0	8 0 0	7 1 8
1906	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 0 10
1907	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 0 0	8 0 0	8 8 4
1908	7 10 0	7 10 0	7 10 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 3 9
1909	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 15 0	6 15 0	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 9
1910	7 0 0	7 0 0	7 1 3	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 10 0	7 10 0	7 10 0	7 5 1
1911	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 14 0	7 10 4
1912	7 18 9	8 0 0	8 0 0	8 7 6	8 10 0	8 10 0	8 10 0	8 15 0	8 16 3	9 0 0	9 2 0	9 5 0	8 11 2½
1913	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	8 19 0	8 15 0	8 5 0	7 15 0	7 15 0	8 17 0
1914	7 15 0	7 15 0	7 15 0	7 13 9	7 10 6	7 5 0	7 0 0	8 0 0	8 2 6	8 5 0	8 5 0	8 5 0	7 15 11½
1915	8 14 0	9 10 0	9 17 6	10 10 0	10 10 0	11 0 0	11 0 0	11 0 0	11 0 0	11 4 0	12 0 0	13 0 0	10 15 5½
1916	13 0 0	13 0 0	13 0 0	12 15 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 12 11
1917	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1918	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1919	13 0 0	15 0 0	15 0 0	15 0 0	19 5 0	19 17 6	21 0 0	21 10 0	21 10 0	21 10 0	21 15 0	23 10 0	18 9 9
1920	26 9 0	28 0 0	28 5 0	28 10 0	29 5 0	30 0 0	30 0 0	30 0 0	30 10 0	31 0 0	31 0 0	31 0 0	29 9 2
1921	30 5 0	29 0 0	25 0 0	25 0 0	25 0 0	23 0 0	21 0 0	20 10 0	19 0 0	17 10 0	16 0 0	14 16 0	22 1 5
1922	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	13 1 8	12 10 0	12 15 0	12 10 0	12 10 0	12 10 0	12 6 0	13 16 9
1923	12 8 9	13 6 0	14 0 0	14 0 0	14 0 0	14 0 0	13 12 6	13 0 0	13 0 0	13 0 0	13 0 0	13 10 0	13 9 1½
1924	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	14 0 0	14 0 0	13 11 0	13 5 0	13 5 0	13 10 11
1925	13 5 0	13 5 0	13 5 0	13 1 0	12 15 0	12 15 0	12 15 0	12 15 0	12 7	11 14 0	11 10 0	11 10 0	12 11 5½
1926	11 10 0	11 10 0	11 10 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 6 3
1927	11 5 0	11 5 0	11 5 0	11 5 0	11 2 6	11 0 0	11 0 0	11 0 0	10 16 0	10 10 0	10 10 0	10 10 0	10 19 0½
1928	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0
1929	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 5 0	10 1 3	10 1 3	10 1 3	10 1 7	10 6 8
1930	10 2 9	10 3 5½	10 3 9	10 3 6	10 2 6	10 2 6	10 2 6	10 2 6	10 2 2½	9 19 6	9 16 3	9 16 3	10 1 6½
1931	9 15 0	9 15 0	9 15 0	9 10 11	9 6 9	9 5 0	9 7 0	9 7 9½	9 8 9	9 5 9	9 5 6	9 9 6	9 9 4½
1932	9 5 0	9 2 6	8 18 6	8 17 6	8 16 6½	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 17 10
1933	8 10 0	8 10 0	8 10 0	8 8 9	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 6 0	8 7 6	8 6 10½
1934	8 8 1½	8 10 7½	8 16 8	8 17 6	8 6 3	8 6 3	8 5 7½	8 5 0	8 5 0	8 5 0	8 5 0	9 5 0	8 11 0
1935	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0
1936	9 5 0	9 5 0	9 5 0	9 5 0	9 8 1½	9 17 6	9 17 6	9 17 6	9 17 6	9 17 6	9 17 6	9 18 1	9 12 7½
1937	10 0 6	10 0 6	10 0 6	10 0 6	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 5 6
1938	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0	11 18 0
1939	11 8 0	11 8 0	11 8 0	11 8 0	11 8 0	11 8 0	11 8 0	11 8 0	11 8 0	11 8 0	12 8 0	12 8 0	11 11 4
1940	12 8 0	13 8 0	13 8 0	13 8 0	13 8 0	13 8 0	15 0 6	15 0 6	15 0 6	15 0 6	—	—	—

WILLIAM JACKS & COMPANY
LIMITED
WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.
13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY
LIMITED
CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2
ZETLAND ROAD, MIDDLESBROUGH.

Notice

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two average 6 words per line Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

FOUNDRY MANAGER desires change. Familiar with progressive methods of foundry production, hand- and power-machine production; also mechanisation for the General Foundry; castings up to 20 tons weight, including mixing of high-duty and alloy cast irons to close specifications; accurate estimating, costing, etc.; accustomed to absolute control of foundries and pattern-shop. Discipline and labour control assured. —Box 520, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

METALLURGICAL CHEMIST required for a foundry in East Anglia. Age between 25 and 30.—Send full particulars of salary required, experience, to Box 542, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

WANTED for one of the largest steel foundries in the country, a General Foreman to take charge of all moulding and coremaking. State age, education, experience and salary required to Box 464, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road. High Wycombe.

FOREMAN wanted for Leicester Iron Foundry. Only men having initiative, strong personality, and being first-class organisers need apply. State age and salary required.—Box 506, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

ASSISTANT WORKING FOREMAN required immediately for Ferrous and Non-Ferrous Foundry in Gloucestershire. State age, full experience and salary required.—Box 534, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

ASSISTANT FOUNDRY FOREMAN wanted for modern Non-Ferrous Foundry engaged largely on Government contracts; permanency to suitable applicant. State fully age, experience and wages required.—Box 538, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

FOREMAN PATTERN MAKER Wanted. Take charge of Inspection and Storage and Pattern Work in a Foundry having no patternshop. To act as liaison with neighbouring patternshop. Midlands district.—Box 532, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

CHARGE HAND FETTLER required, Works in safe area. Medium to heavy castings. Pneumatic grinders, chisels and good lifting tackle available.—Box 528, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

EMPLOYMENT REGISTER.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

FOUNDRY MANAGER, can take full control, non-ferrous foundry, including aluminium, technical, practical and managerial experience. Costing. Willing to consider investment or partnership. (389)

SITUATIONS VACANT AND WANTED—*Contd.*

FOUNDRY FOREMAN desires position; Ferrous and Non-Ferrous. Hydraulic, automobile and general castings. Twenty years' experience. (395)

FOREMAN, experienced high duty and grey iron up to 26 tons, non-ferrous including aluminium and magnesium alloys, requires position. Accustomed mechanised foundries. (396)

PROPERTY

FOR IMMEDIATE DISPOSAL, Works Premises at Union Street, Rotherham, previously used as Iron Foundry. Area approximately 13,000 square feet, with buildings about 10,000 square feet. Private Sidings and main road access. Wired throughout Rotherham Corporation Electricity. Corporation Gas available. Main buildings 130 feet long, 25 feet wide, 21 feet high (13 feet to eaves); 2 ton travelling crane. Land leasehold (the usual railway lease). Price £2,300, or nearest offer. Possession on completion.—Apply Box 530, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

MACHINERY

WE WANT TO BUY

Secondhand
CRUDE OIL ENGINES. STEAM ENGINES. BOILERS. : PUMPS. ELECTRIC GENERATING SETS. : MOTORS. EXCAVATORS. LOCOMOTIVES. CRANES.

● *All are required for work of urgent National importance.*
If you have available any such plant, offer it to us without delay. We will either purchase outright or negotiate the sale on a commission basis.

GEORGE COHEN
SONS & CO., LTD. (Est. in the year 1834)
Wood Lane, LONDON, W.12. SHEpherds Bush 2070.
Stanningley Works, Nr. LEEDS. Stanningley 71171.
And at Birmingham, Sheffield, Manchester, Bristol, etc., etc.

WANTED, Cumming Crucible Furnace.—Box 540, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

WANTED, SAND SLINGER, stationary portable type, with long ramming arm.—Full particulars and price to Box 536, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

CUPOLA, complete with fan and motor and staging, wanted immediately. Capable of melting 3 to 5 tons grey iron hourly.—State terms to Box 512, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

SAND MIXERS AND AERATORS.—The "Breakir" Centrifugal Machine is *THE* machine. Outputs 10 cwts. to 8 tons per hr.—W. BREALEY & Co. LTD., Station Works, Ecclesfield, Sheffield.

THOS. W. WARD, LTD.

VERTICAL PLUNGER PUMPS.

3 rams, 5½ in. by 10½ in. stroke, 3 in. suction and delivery, motor driven by 15 h.p. Westinghouse motor, 500 v. d.c., by J. T. Williams & Sons.

3 rams, 3½ in. by 4 in. stroke, 2 in. suction and delivery, 30 ft. head, motor driven. By Submersible & J. L. Motors.

3 rams, 3 in. dia. by 3 in. stroke, 2 in. suction and 1½ in. delivery, 1,140 gallons per hour, motor driven. By Small Electric Motors.

3 rams, 2⅞ in. by 5 in. stroke, 2½ in. suction and delivery, belt drive, fast and loose pulleys.

Write for "Albion" Catalogue.
ALBION WORKS, SHEFFIELD
'Grams: "Forward." 'Phone: 26311 (15 lines).

MACHINERY—*Continued*

CUPOLAS

2 ft. 6 in. dia., 15-cwt. per hr. Cupolette.

PNEUMATIC MOULDING MACHINES

Macdonald Jolter, table 72 in. by 54 in.

Tabor 16-in. Shockless, table 72 in. by 48 in.

Tabor Portable Shockless Rollover, table 40 in. by 30 in.

Tabor ditto, table 27 in. by 20 in.

Tabor 21 in. by 16 in. squeeze.

Zimmerman Type R.P.W. 2 Jolt Squeeze turnover, table 36 in. by 20 in.

Mumford Type (Jackman) Swing Headpress, 13 in. by 15 in. and 14 in. by 16 in.

Mumford Pneumatic Core Jolters having 15-in. by 20-in. and 12-in. by 12-in. tables.

Britannia No. 1 "Coventry" Pneumatic Turnover Jarr Ram, table 30 in. by 28 in.

50 Air Compressors; 500 Electric Motors, Dynamos, etc.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD, LANGLEY,
Nr. Birmingham.
'Phone: Broadwell 1359.

FOR SALE, 15-cwt. Cupola, with fan and motor; nearly new condition.—WHITEHEAD & POOLE, LTD., Radcliffe, nr. Manchester.

FOR SALE, one 10 ton 24 in. bore Jolt Ramming Machine (manufacturers John MacDonald, Ltd., Glasgow), in good condition. Can be inspected any time by appointment.—Apply Box 526, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

MISCELLANEOUS

PATTERNS IN WOOD AND METAL for all branches of Engineering. Moulding methods carefully considered.—FURMSTON & LAWLOR, Letchworth.

FOR SALE.—Wire suitable for Core Making, ⅛ in., 1/16 in., ¼ in. thick; 4 tons in all; will sell small lots, price £12 10s. per ton; can send sample.—PORRITT, Mayfield, Mirfield, Yorks. Telephone: 3218.

1,100 MOULDING BOXES, from 1-ft. sq. to 5 ft. 6 in. by 3 ft. 9 in.; depths 6 in. to 12 in.—Apply, Box 544, Offices of THE FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

'Phone: 22877 SLOUGH

TWO NEW Core blowers for bombs.

36" Cupola by Geo. Green.

48" Cupola by Constructional.

54" Cupola by Thwaites.

JOLT SQUEEZE "JACKMAN" MOULDING MACHINES, 14" x 16", as new. £90 each.

Morgan 250 lb. Tilting Furnace (Two).

Morgan 600 lb. Oilfired Tilter.

Lip Axis 800 lb. Oilfired Tilter.

NEW PIT FURNACES 150 lbs. capacity, oil or coke fired. £35 each.

NEW SHOTBLAST CABINET PLANTS with motor driven Exhaust Fans, complete, all sizes. Prompt delivery.

ALEX. HAMMOND, *Foundry Machinery Merchants.*
14, AUSTRALIA ROAD, SLOUGH
BUY FROM ME AND SAVE MONEY.